GOVERNMENT OF INDIA
MINISTRY OF IRRIGATION

REPORT
OF
COMMITTEE ON COST CONTROL
OF
RIVER VALLEY PROJECTS

VOLUME-I

NEW DELHI
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GOVERNMENT OF INDIA
MINISTRY OF IRRIGATION
CENTRAL WATER COMMISSION

REPORT
OF
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OF
RIVER VALLEY PROJECTS

VOLUME I

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No.1/4/77-R&C
Government of India
Committee on Cost Control of River Valley Projects

Central Water Commission
Sewa Bhavan, R.K.Puram,
New Delhi-22, the 30th January 1981.

To

The Secretary to the
Government of India,
Ministry of Irrigation,
Shram Shakti Bhavan,
New Delhi-110001.

Subject: Committee on Cost Control of River Valley Projects submission of Report.

Sir,

Under Office Memorandum No.17(26)/76-MPE dated 25th February, 1977 of the then Department of Irrigation of the Ministry of Agriculture and Irrigation, Government of India, the Committee for Cost Control of River Valley Projects was set up to examine the various aspects of Cost Control on River Valley Projects. In the 14th meeting of the Committee held on 28th & 29th January, 1981 the Committee has accepted the report and have authorised me to forward it to you.

The report of the Committee comprises Five volumes as below:-

Volume - I	Report and recommendations on the specific terms of Reference,
Volume - II	Analysis of Rates both for Manual as well as Machinery Works.
Volume - III, IV & V.	Representative Specifications.

The Committee held 14 meetings since its constitution. The first meeting was held on 25th April, 1977 and the last on 28th & 29th January, 1981. As the work of the Committee proceeded, it was realised that the scope of work was very wide and it would not be possible for the Committee to give full justice to the assigned work unless a full time Secretary with adequate staff was made available. Proposals for creation of a full time Secretary's post for the Committee, as was done at the time of the previous Cost Committee (1964), were formulated and submitted to the Government for necessary sanctions. However, for various reasons this proposal was not accepted by Government and only a post of a Director to work as full time Member-Secretary of the Committee with some skeleton personal staff to the Member-Secretary was sanctioned vide the then Ministry of Agriculture & Irrigation(Department of Irrigation) letter No.1/31/78-Admn.-I dated 17th May, 1978. Since with this skeleton staff the Committee would not have been able to carry out the work which was envisaged to be done to comply with fully the terms of reference, the Committee decided that the work may be done to the extent possible with the sanctioned staff and identify the areas for further work in their report.

The Committee also formulated a comprehensive Questionnaire and sent it to all the Irrigation Departments of the States and also the Chief Engineers of projects, basically with a view to collect field information on costs and cost analysis. The response to this Questionnaire from the field agencies was not at all adequate. When the Questionnaire was drafted and sent, it was intended that the various data included in the Questionnaire would be collected if necessary, by the officers of the Committee Secretariat, by personal contacts with the project authorities and analysed with a view to formulation of certain parameter for reasonable anticipation of future construction cost such as construction cost indices for important items and also to indicate guidelines for future data collection and analysis. For obvious reasons, this was not possible. In the circumstances, in order to expedite the work of the Committee, six sub-committees were formulated to prepare draft chapters on some of the items pertaining to this report. The details of the sub-committees are dealt with in paragraph 1.12 of the report. The sub-committees held a number of meetings and as a result of which draft chapters were formulated by them. These chapters were subsequently discussed in the Committee's meetings and were finalised for incorporation in the report.

The Volume-I of the report indicates the recommendations of the Committee on the various terms of reference. The recommendations of the Committee on various aspects have been summarised in Chapter-XI, of the report (Vol-I).

The Committee realised that there was considerable scope for adopting Labour Intensive Technology on River Valley Projects. However, keeping in view the problems and the targets for River Valley Projects,

mechanisation on projects cannot be avoided. The Committee, therefore, have recommended a flexible approach for adoption of Labour Intensive/ Machinery Intensive Technology for River Valley Development Projects suited to the circumstances of the each of the project and keeping relative economic in view. Adoption of Labour Intensive Technology is also likely to pose some problems of labour management which would also need careful attention of the project management. Presently, there is no comprehensive Labour Legislation to cover all the activities involved in the River Valley Projects and a large number of Laws and Acts are applicable to the various labour oriented activities on River Valley Projects. There is some need to consider unification of these Laws. The problems of providing the necessary amenities to the Labour may also have to be considered carefully. The Committee also feels that to increase the productivity of the Labour, some sort of the job training scheme may also have to be considered.

In respect of Standard Description of main items of Universal Nature in Rationalised Units, the Committee have identified 57 important items. In respect of Standard Description of these items the Committee feel that the description as indicated in the tender should be brief which will enable identification of the item and leaving the scope of the work under the item to be clearly defined in the specification or other operative parts in the tender in unambiguous terms. Against these identified items the Committee have indicated the Units that may be adopted. It is understood that Indian Standard Institution has also constituted a Committee to consider this aspect of standardisation. After their recommendations in this regards are received the recommendations of the Committee may be reviewed in relation with respect to Indian Standard Institution recommendations and a standard system of Units of measurement be adopted in the country as a whole.

The Committee also went in the question of preparation of Standard Specifications for main items of River Valley Projects. For obvious reasons it was not possible for the Committee to draft Standard Specifications. The Committee also felt that the specifications will have to be prepared taking into consideration the specific requirement of the work at a particular site and as such preparation of Standard Specification which will be applicable to an item of work in all the River Valley Projects will not be practicable. However, there were some areas where such standardisation can be attempted. The Committee also considered whether Indian Standard Specifications could be directly used as contract specifications. Whereas the Committee appreciated the utility of Indian Standard Specifications as guidelines, these specifications were not considered suitable as contractual specifications. However, the Committee recognised that in respect of Standard Items of input such as Cement, Steel as well as Standards for tests, tests procedures, evaluation of results etc. Indian Standard can be directly adopted by giving a cross reference to these specification in the contract

documents. However, Committee recognised the need to make some effort on standardisation. They also have seen that some efforts on standardisation is being made in some of the States. This effort may have to be continued and the synthesis of Standard Specifications framed by several States and the Departments with a view to evolve a generalised standard specifications should be done by a special cell on a continuing basis as a whole time job. The Committee feel that this work can be undertaken in a Central Organisation like the Central Water Commission.

In respect of standard methods of measurement, the Committee recognised the need for having a national standard. The Indian Standards Institution have also brought out Indian Standards for Methods of Measurements of Buildings Civil Engineering Works in 25 parts covering the various items required for works pertaining to buildings. A separate Committee has also been set up by Indian Standards Institution to formulate standards for Method of measurement of works for multi-purpose river valley projects. The standard methods of measurements as per recommendations of this Committee of Indian Standard Institution may be adopted in all river valley projects.

In respect of analysis of rates, the Committee wanted to carry out analysis of costs of items being executed on river valley projects in the country. However, since factual information in respect of costs could not be collected, the Committee made an attempt to analyse the operations involved in the various important items of work on river valley works and have indicated guidelines for preparing the rate analysis for purposes of preparation of project estimates. These are included in Volume II of the Report.

Chapter VII is devoted to materials management and inventory control. Essentially, the materials management and inventory control will be more relevant in large projects where work is being done departmentally and especially where large fleet of earth moving and other equipment will be deployed. Where works are done on contract, the items of inventory could be very limited which could be handled by using conventional methods so far adopted. For projects with high inventories, it is necessary to creat Inventory Control Cells for materials management. It is also considered necessary that the personnel manning the materials management are trained in the modern system and techniques of materials management.

The system of performance budgeting is not adopted as it should be in many of the river valley projects, although some system does exist.

The Committee recognise the need for performance budgeting and realised a number of limitations that exist in strict observance of this system. The Committee have attempted to formulate a standard proforma for performance budgeting and this is enclosed as an Annexure X to Volume I of the Report. By way of sample, performance budgeting formats adopted by National Thermal Corporation Ltd., and also National Hydroelectric Power Corporation Ltd., have also been included as an appendix to Volume I of the Report.

The Committee also feel that there should be a continuous effort at cost analysis and cost review on the river valley projects Although efforts have been made by the Government of India from time to time to ensure that cost control cells are created at every project and also at the State level, the efforts have not been successful to the desired degree. The Committee after discussions have suggested creation of State level cost accounting cells as well as project level cost accounting cells with slight modifications in the structure. The functions of the cost control cells have also been defined. The Committee also recognises that there is need to training of all the incumbents on the posts in the cost of account cells in the technique of cost accounting.

One of the terms of reference of the Committee was to evaluate the performance of output of indigenously manufactured and imported earth moving equipment and to lay down norms. The Committee used the data of time motion studies carried out by the Central Mechanical Organisation of Central Water Commission. However, since the studies were limited and the job conditions varied, it was not possible to arrive at generalised norms of output. The conclusion of the studies presented in Chapter X will indicate the directions in which further studies to evolve such norms should be continued. This is a regular and full time job. This work at present is being carried out by the Chief Engineer, Central Mechanical Organisation, Central Water Commission. This work should continue with strengthening of the organisation as may be necessary. The objective in this study will be to evolve a system of rating of the job factors and the management factors in the operations of the heavy earth moving equipment, so that they could be used in conjunction with the standard out put under ideal conditions to reasonably assess in advance and review during the construction the costs of work. The Committee also recognise that there is the need for training the officers handling the equipment such training should be imparted both in India and also abroad. Such training programmes were carried out in the past. The schemes of such training could be appropriately revived. The Committee also recognise the need of training the operating staff for this heavy equipment, for which special arrangements may have to be made by the project/central authorities.

The Committee found some difficulties during its working which they feel it appropriate to bring to your notice. One of the difficulties

was the frequent changes in the membership of the Committee. Although, some changes may be inevitable during the course of the work of a Committee and it is necessary that these changes are kept to the minimum. In this direction, the committee feel that once certain officers are nominated as members of the Committee this assignment should go to them as personal assignment. This might help in keeping continuity for discussion of the Committee. This will also require that the Committee have an appropriately staffed secretariat which will work under the directions given to it by the Members of the Committee. In the present case the Committee had five Member-Secretaries. This created considerable difficulties in the working of the Committee. This may be considered while appointing similar committees in future.

Before I close, I must acknowledge the invaluable assistance which I have received from all the members of the Committee, who inspite of their busy schedule of works took upon themselves completion of the various assignments given to them during the course of the deliberations of the Committee. I must also make a mention of the contributions done by the Member-Secretaries. Unfortunately, Shri S.I. Matharani, Member-Secretary during the period 30-12-1978 to 15-2-80 suddenly expired on afternoon of 15.2.1980. However, he had contributed his mite to the works of this committee in spite of his indifferent health about which he did not even made a mention any time. The Committee also recognise the work put in by the present Member-Secretary Shri B.M. Lalvani, who after his return from Iraq and on being appointed as Member-Secretary spared no efforts to complete this work within as short a time as possible. The Committee understand that Mr. Lalvani is due to retire on 31st January, 1981. The Committee take this opportunity to wish all the best to him during his retired life. The Committee would also want to make a special mention of the excellent work done by Shri R.L. Gupta Executive Engineer, Irrigation Department, U.P. who enthusiastically assisted the Committee in preparing the various format for the rate analysis.

I have now pleasure of forwarding the Report of the Cost Control Committee in Five Volumes with the hope that the recommendations will be useful in the various river valley project in the country. Only two copies of Volume I and one copy each of Volume II to V, have been forwarded. Within the limitation of time, it has not been possible for the Committee Secretariat to take out more number of copies of its report and the other volumes.

Thanking you,

Yours faithfully,

(M.G. PADHYE)
Chairman,
Committee to on Cost Control of
River Valley Projects.

Copy to the Chairman, C.W.C.
New Delhi.

I. INTRODUCTORY

CHAPTER-I

INTRODUCTORY:

1.01 Since Independence a large number of Irrigation and Multi-purpose Projects have been taken up for construction in the country. While the benefits of irrigation accuring from these projects have greatly helped in increasing the agricultural production in the country, the mounting cost of the frequent revision of the project estimates and consequent delay in the completion of the projects and actual of the benefits therefrom have been causing great concern to the Government.

1.02 The need to control cost and watch the departmental working rates or the rates being accepted on continuous basis, measures to utilise on continuous basis the vast man power available on river valley projects and management of projects by introduction of modern techniques has been receiving the attention of the Government.

1.03 The Government of India, Ministry of Agriculture and Irrigation, (Department of Irrigation) therefore, decided to refer this question to Committee of experts and the Committee constituted for the purpose under O.M.No.17(26)/76-MEF, dated 25th February, 1977 and as modified subsequently comprised of the following:-

LIST OF MEMBERS AS ON TO-DAY:

1.	Shri M.G. Padhye, Member (P&P), Central Water Commission, New Delhi.	Chairman
2.	Shri V.B. Patel, Chief Engineer & Jt. Secretary to Govt. of Gujarat, Sachivalaya, Gandhi Nagar.	Member
3.	Shri J.S. Naphray, Chief Engineer (C.M.O.), Central Water Commission, New Delhi.	Member
4.	Shri J. Raja Rao Chief Engineer (M.I. & Genl.) Government of Andhra Pradesh, Hyderabad.	Member
5.	Shri G.G. Puri Chief Engineer (E/M), Government of Madhya Pradesh, Bhopal.	Member

6.	Shri J.R. Malhotra, Chief Engineer (Irrigation) Government of Madhya Pradesh, Bhopal.	Alternative Member
7.	Shri R.K. Jain, Addl. Chief Engineer (Dams, Design), Government of Uttar Pradesh, Roorkee.	Member
8.	Shri A. Nagabhushana Rau, General Manager, M/s. Hindustan Const. Co., Ltd., Walchand Hirachand Marg, Bombay-58.	Member
9.	Shri C.R. Mukherjee, F.A. & C.A.O. Beas Project, Punjab.	Member
10.	Shri G.C. Mathur, Director (N.B.O.), Nirman Bhavan, New Delhi.	Member
11.	Shri B.M.K. Mattoo Financial Adviser, Department of Irrigation, New Delhi.	Member
12.	Shri A.K. Biswas, Ex-President, Institute of Cost & Works Accountants of India Calcutta.	Member
13.	Shri D. Ajitha Simha, Director I.S.I. Manak Bhavan, New Delhi.	Member
14.	Dr. N.P. Tolani, Managing Director, M/s. Tolani Engineering (Pvt) Ltd. Bombay.	Member
	(Shri K.C. Chablani, General Manager, Tolani Engineering) Pvt. Ltd., Bombay.	Alternative Member

15. Shri B.M. Lalvani, Director, Central Water Commission, New Delhi. — Member-Secretary.

Specifying the terms of reference the Office Memorandum stated:

(i) The Committee will study and suggest measures of exploitation to the fullest extent of the labour resources available in the country on a continuing basis on Water Development Projects with due consideration to the changed context in the construction work and increased degree of mechanisation necessary, presently and in times to come.

(ii) To set down national norms for specifications and format for rate analysis for Water Development Projects Comprising:

a) Standard description of main items of universal nature in rationalised Units;

b) Standard specification in consonance with Indian Standards in order to remove the present inconsistencies which are very often exploited resulting in loss to Government. These specifications should be clearly and unambigously worded to enable proper quality control.

c) Standard methods of measurement particularly for items like earth-work in embankments, boulders staking and placement, over break in tunnelling etc.

d) Analysis of rates both for manual as well as machinery works based on standard constants of labour, material, tools and plants etc., in different zones of the country.

(iii) To suggest measures for introduction of modern system and techniques of material management and inventory control, performance budgeting system, adopting modern practices, resorting to computerisation etc.

(iv) To suggest general guidelines on the structure and functions of the cost accounting cell which is being set up in the projects/States on the recommendation of the State Irrigation Minister's Conference of July, 1975.

(v) To study performance and outputs of indigenously manufactured/imported Earth Moving Machinery and lay down norms.

Shri M.G. Padhye (Member P&P) was nominated as the Chairman of the Committee when he was Chief Engineer (Non-II) C.W.C. He continued

to remain as Chairman of the Committee on his taking over charge as Member (P&P) Central Water Commission.

The date of submission of report was February, 1978; this was later extended by Government to the end of December, 1980.

1.04 Almost within three months of the constitution of the Committee Shri Jagman Singh, Managing Director, Minor Irrigation Corporation, Haryana was withdrawn for WAPCOS assignment to Afghanistan and in his place Shri G.G. Puri Chief Engineer (E/M) Irrigation Department of Government of Madhya Pradesh was nominated in December, 1977. Shri Hari Mohan, Addl. Chief Engineer, U.P. informed in September, 1977 that as he had assumed charge in the secretariate, he would not be able to devote much time to Committee and was replaced by Shri Vijendra Singh, Addl. Chief Engineer, in December, 1977. He in turn was replaced by Shri R.K. Jain, Addl. Chief Engineer (Designs) Roorkee on 16.3.1979.

1.05 Shri J.A. Murrary, Chief Engineer (M.I.& Genl.) Irrigation Department, Andhra Pradesh retired from service on 31st October, 1978. Shri J. Raja Rao, Chief Engineer was nominated in his place on 15.9.1979. Shri A.S. Kurpad, Chief Engineer (Ex-Deputy Adviser, Bureau of Public Relation) retired from service and left for assignment out of India to Phillipines. Shri J.S. Naphray, Chief Engineer (C.M.O.) Central Water Commission was nominated in his place on 27.9.1979.

1.06 From the inception till 18th month, Shri Mahesh Chand Ex-Director (R&C) C.W.C. was the Member-Secretary of the Committee. Consequent to creation of the post of Director in C.W.C. to function as Member-Secretary. Shri M.G. Ajwani, Director, C.W.C. was nominated as Member-Secretary vide Ministry of Agriculture & Irrigation (Deptt. of Irrigation) O.M. dated 27.6.1978. He did not join this post as he was already in the other charge. Subsequently Shri C.R. Chopra, Director, C.W.C. was posted as Member-Secretary of the Committee w.e.f. 29.7.78 (A.N.) in place of Shri Mahesh Chand. Shri S.I. Mathrani, who took over from Shri C.R. Chopra as Member-Secretary on 30.12.1978 had been keeping indifferent health for some period and suddenly expired on 15.2.1980. In his place Shri B.M. Lalvani, took over as Member-Secretary in the afternoon of 22.2.1980.

1.07 The Committee met 14 times of which the first and fifth to fourteenth meetings were held in Delhi on 25th April 1977, 1st March, 1978, 6th October, 1978, 17th October, 1979, 28th January, 1980, 5th & 6th August, 1980, 9th & 10th October, 1980, 18th November, 1980, 23rd December, 1980, 16th & 17th and 28th and 29th January, 1981 respectively. The other three meetings were held on project sites. The members of the Committee visited Nasik and mechanical workshop at Dapodi, Poona. At Nasik, they had discussions with the representatives of the Irrigation Department of Maharashtra Government. The members next visited

Dakpathar (Dehradun); after the inspection of highly complicated work of Ichari Diversion Dam and Chibrao Power House, and Head-works of Rishikesh-Hardwar Hydel Schemes, the Committee had discussions with the private contractors and project engineers. The fourth meeting of the Committee was held at Hyderabad and Nagarjunasagar Project site. The Committee members met the Secretaries to the Department of Irrigation and Power and of Labour of the Government of Andhra Pradesh and Several State Officers of Irrigation and Power Deptt., for exchange of views and suggestions of the subject concerning the terms of reference.

MODUS OPERANDI:

1.08 During the initial three sittings the Committee finalised Questionnaire for collections of information on the various terms of references posed by the Government. This is kept at Annex. XVII. The Questionnaire was circulated among all the Secretaries/Chief Engineers of State Governments, Chairmen of State Electricity Boards, General Managers of various Construction Agencies in Public and Private Sectors.

Assistance by way of views and suggestions was also sought from Public Administration, Ministries of Railways, Defence, Indian Institute of Labour Bureau. A copy of the Questionnaire was sent to the U.S. Bureau of Reclamation and/also to Army Corps of Engineers. Unhappily the response to the Questionnaire was nil.

1.09 In the fourth meeting of the Committee held at Hyderabad from 4th to 7th October, 1977 it was decided to distribute the work relating to various terms of references amongst the working groups. The fifth meeting was held at Delhi on 1st and 2nd of March 1978. This meeting was primarily called to review the work done by various working groups. Suggestions from the members were invited on ways and means to secure response to questionnaire which had been almost nil till then. There were about 500 projects in the country and the task was huge. The data of these was available some where but the problem arose of its compilation. It was opined that for replying to questionnaire, which called for extensive information, the project engineers may have to do lot of exercise, especially as the data bank with them was very poor.

1.10 In view of the project authorities reluctance to collect the information on behalf of the Committee due to problems of compilation it was felt that the question of getting replies to the questionnaire and data from the States may have to be pursued by the members on personal and individual level. It was finally decided that the projects, the methodology of collecting data and its compilation be left to the discretion of the working groups.

1.11 During the subsequent meeting (6th), while reviewing the position regarding collection of data, it was observed that the process

of collection of data and replies to questionnaire was still not very encouraging. It was, however, felt that in some cases the data which was available with some project authorities; had to be routed through proper channel of the State Government and this was probably causing this inordinate delay. The Committee then decided to take up the matter with State Government in continuation of Department of Irrigation's letter dated 6.12.1977 requesting that the individual State Officer, who were addressed by the Committee may be permitted to send replies directly in their individual capacity and the views of the State Governments could be sent separately.

1.12 The information as received from the States were circulated amongst the Working Groups for their studies, so that individual members can express their ideas on the skeleton of the report of the Committee so that this aspect could get a more concrete shape. During the seventh meeting of the Committee held at Delhi on 17th October, 1979 - it was clarified to the members that it would not be possible to obtain staff required for the work as envisaged in the earlier meetings and within these limitations the Committee may have to find a way to complete the assignment. it was felt that based on wide range of experience the members of the Committee had, an attempt may made to prepare an outline of the Chapters so that these could be supplemented and improved upon. It was decided that after skeleton was finalised the first draft Chapter would be prepared by the members as mentioned hereunder for further consideration of the Committee.

1.	Shri V.B. Patel, Chief Engineer (Project) & Jt. Secy., Gujarat.	Chapter on Labour Utilization (Terms of Reference No.I)
2.	Shri J.R. Malhotra Chief Engineer (Irr.) Bhopal (M.P.)	Chapters on Standard Specifications and Method of Measurements (Terms of Ref. II (b) & (c)
3.	Shri R.K. Jain Addl. Chief Engineer (Designs) Roorkee.	Chapter on Standard Description of main items and Analysis of Rates (Terms of Ref. II (a) & (d)
4.	Shri J.S. Naphray Chief Engineer (C.M.O.) Central Water Commission.	Chapter on Techniques of Material Management and Inventory Control, Performance and Output of Earth Moving Machinery (Terms of Ref. III & V).
5.	Shri C.R. Mukherjee FA&CAO, Bhakra & Beas Management Board.	Chapter on Material Procurements Performance Budget & Cost Cells (Terms of Ref. III & IV).
6.	Shri A.K. Biswas, Cost Accountant	Chapter on Performance Budgeting and Cost Cells.

1.13 While framing the rate analysis, the changes in the technology of construction in the past few years have been kept in view as the break up of the operations of various items differ from what is being adopted in the conventional analysis.

1.14 A review of contract specifications of works adopted by various States show that every State project evolves its own specifications. It is felt that no uniform contract specification, centrally drafted, can serve the purpose of every project due to inherent variations from project to project, as well as in local practices and availability of local materials required to be used to ensure economy in construction. It is, however, felt that in a large number of items connected with River Valley Projects, a standard pattern of Uniform Contract Specifications can be drawn up. The effort has made to obtain for reference and guidance of the project authorities Contractual specifications listed hereunder for a few of the major projects taken up recently for construction:

i)	Construction of Earth Dam	Rajghat Dam Project - U.P.
ii)	Construction of Masonry Dam and Appurtenant works.	Rajghat Dam Project - U.P.
iii)	Construction of Earth Dam	Adopted by Madhya Pradesh authorities.
iv)	Construction of Masonry Dam and Appurtenant works.	Adopted by Madhya Pradesh authorities.
v)	Construction of Rock-fill Dam Across River Chenab	Salal Dam - Jammu & Kashmir
vi)	Design and fabrication transportation to site and errection of Radial Crest gates of size 15M x 12M for spillway of Dam block 54 to 59 of Naranpur Dam	Naranpur Dam Upper Krishna Project Karnataka

1.15 The draft Chapters framed by the members have been examined and discussed at length in the 8th to 13th meetings of the Committee held on 28th January, 1980 5th & 6th August, 1980, 9th and 10th October, 1980, 18th November, 1980 23rd December, 1980 and 16th & 17th January, 1981.

Committee feels that the results of deliberations which are recorded in various Chapters will introduce beneficial changes in execution of the projects, framing of the cost estimates and contractual specifications in the various river valley development projects in the country.

1.16 The report has been divided into 5 Volumes. The report as the result of deliberations containing recommendations of the Committee on specific terms of reference and the letter of Transmittal are in Volume (I).

Volume I is divided into - Chapters as given below:

CHAPTER	I	Introductory:
CHAPTER	II	Labour Utilisation on River Valley.
CHAPTER	III	Standard Description of main items of Universal Nature in rationalised Units
CHAPTER	IV	Standard Specifications in Consonance with Indian Standards.
CHAPTER	V	Method of Measurements
CHAPTER	VI	Analysis of Rates both for Manual as well as Machinery works.
CHAPTER	VII	Techniques of Material Management and Inventory Control.
CHAPTER	VIII	Performance Budgeting.
CHAPTER	IX	Structure and functions of Cost Accounting Cells.
CHAPTER	X	Performance output of Indigenously manufactured Imported Earthmoving machinery and norms.
CHAPTER	XI	Summary of Recommendations.
		Annexes.

Volume II, III, IV & V of the report consists of the following:

Volume II	Format of the analysis of rates both for manual as well as machinery.
Volume III IV & V.	Representative Contractural specifications of Masonry Dams, Earth Dam, Rock-fill dam, Spillway Radial Gates.

II. LABOUR UTILISATION ON RIVER VALLEY PROJECTS

CHAPTER II

II."LABOUR UTILISATION" OF RIVER VALLEY PROJECTS

INTRODUCTION:

2.01 Human labour is one to the main and vital input for any development activity. In the field of agriculture and irrigation, labour is the backbone of development. The Irrigation projects, particularly the major and medium schemes not only provide substantial employment opportunities during their execution, but also under command area development works, such as land levelling, field channels, field drains etc. The estimated input of labour for irrigation and flood control projects is about 40 to 70% of the total investment. It has thus significant contribution to make.

2.02 Prior to 1951, the total area irrigated in the country was 22.6 m. ha (9.7 m. ha by major and medium project, and 12.9 m. ha by minor schemes). By the end of 1973-77 the irrigation potential in the country rose to 44.2 m. ha., (20.7 m. ha from major & medium irrigation projects and 23.5 m. ha from minor irrigation projects.) The average rate of creation of irrigation potential from major and medium projects was not more than 0.5 m.ha, annually in any of the plans executed upto 1973-74.

During the periods 1974-80, the average rate of creation of irrigation potential from major & medium projects was little over 1.1 m. ha per year. By end of 1979-80, a total potential of about 57 m. ha will be created through execution of all categories of Irrigation Schemes and an addition of 7.5 m. ha has been agreed through major & medium irrigation projects as a national target for the 6th Plan (1980-85). This manifold increase in the activities demands greater and greater labour force. Competing demands of other sectors, agriculture in particular, have also increased. The appropriate growth of labour force, it is found, is lesser than the growth of the demand for labour Further periodic seasonal and regional variations in the demand greatly influence the availability for individual operations. Consequently, a need has arisen to study and suggest suitable measures for exploitation to the fullest, extent of the labour resources available in the country on a continuing basis.

2.03 In the past, immediately after independence, the Government of India, had taken up large and important river valley projects in the first Five Year Plan, but due to large variations in cost, and under-estimation, due to inadequate information on the rates, the cost of river valley projects was needing frequent revisions, resulting in demand and periodic revision of additional funds. The Government of India had, therefore,

appointed a committee of experts, under Chairmanship of Shri P.C.Agarwal, I.S.E.(Retd.) Ex-Chief Engineer, U.P. with two other members under Ministry of Irrigation and Power's letter No. DW-III-7(I) dated 16.2.54. The Committee had examined about the rates of important items of work like earthwork of dams, dykes, excavation of foundations of dams and weirs, drilling and grouting, concreting, masonry, gate works, etc., done both mechanically as well as by deployment of manual labour. This Committee had summarised their various recommendations in the Report of the Rate and Cost Committee part I and II published - in January 1956. Two major recommendations for the labour component and rate structure of works are:-

i) For river valley projects, a coordinated development and economy in man-power and equipment; and

ii) a system of incentive in the shape of overtime, bonus and recognition of merit be introduced.

The Rates and Cost Committee's Report was discussed at the Hirakud Seminar in January, 1957. The recommendations of the Rates & Cost Committee contained in the Part-I of the report, as modified by the findings of the team of officers, were brought to notice of the State Governments.

2.04 The Government of India, Ministry of Agriculture and Irrigation (Department of Irrigation) had set a Committee to examine the various aspects of labour employment in Major/Medium Irrigation Sector for 8 million ha., irrigated land programme target under Chairmanship of Shri S.B.Khare, Joint Secretary (G.B.) Department of Irrigation,Government of India. The Special terms of reference under the letter No. 71(i)/78-Co-ordination dated 18.1.1978 appointing the Committee were:

i) To assess the quantum of labour employed at present both on departmental and contract works, covering categories like skilled, semi-skilled and unskilled labourers, from local and other States for river valley projects.

ii) To assess requirements of labour for 5 years from 1978-83.

iii) To analyse strength of labour for different working seasons, and continuity of work for labour.

iv) Wage structure to be analysed from prevailing practices of employment of labour force.

v) To compare productivity of labour and wages earned.

vi) To recommend measures to improve productivity of labour, a make available opportunities for constant work, and improve the health standards of labourers.

vii) To suggest appropriate methods of employment of labour and avoid middle man's profit.

The report of the Committee was published in 1978.

ASSESSMENT OF LABOUR REQUIREMENT:

2.05 Item of Work:

The irrigation projects are at present being executed mostly through the contractors. There are, however a few projects like, Ramganga and Beas-Sutlej Link and to some extent Rajasthan Canal, which have been executed through heavy equipment as well as by employing manual labour as necessary. Other projects, certain items of works such as earthen flanks of composite dam, earthwork in large canals, foundation of barrages and other important works are done departmentally, employing various types of equipment. Where the works spread over the large areas, such as net work of canals and drains, the work is done contractually mostly by local contractors employing local labour to the maximum possible extent. In recent years, many State Governments have set up construction corporations, to name a few the Gujarat State Construction Corporation, the Andhra Construction Corporation, the Bihar Construction Corporation and the Bridge Corporation of Uttar Pradesh, which take up most of construction in river valley projects. In many States, the works were being carried out by employing piece workers. In some cases, the efforts of piece workers were supplemented by the use of departmental machinery for certain operations such as drilling transport etc.

2.06 For the river valley projects, thus there is quite an appreciable opportunity of providing employment to unskilled labourers, semi-skilled labourers and skilled labourers. The major items of works needing the labour force can be briefly enumerated as under:-

A) Masonry/Concrete dams:

i) Excavation of overburden/rock foundations, including disposal through transport vehicles.

ii) Collection of fine/coarse aggregates including screening, carting etc.

iii) Quarrying operations for rubble of masonry and its transport.

iv) Laying masonry and concrete.

v) R.C.C. work including placing bars and erection of centerings.

vi) Fabrication for structural work.

B) Earth Dams:

i) Excavation of cut-off trench, drains and earthwork in small quantities for supplementing in approaches not available to mechanised equipments.

ii) Filters and pitching work including rock toes.

iii) Turfing of slopes.

C) Canals:

i) Excavation of small canals with bed widths upto 4 M and depths 6 M.

ii) Distribution systems and C.D.Works.

D) Miscellaneous:

i) Earthwork of approach roads to various sites.

E) Gates:

i) Sluice and crest gates, workshops.

F) Buildings:

i) The residential and non-residential buildings needed for Headworks, canals, for implementation of Project Works.

Classification of Labour:

2.07 The labour employed for above enlisted works can be broadly classified into four major classes:-

(a) Supervisory: Field workers like Assistant Engineers, Junior Engineers, Foreman, Chargeman are covered in this class.

(b) Skilled: The category of workers like drillers, masons, stone-cutters, carpenters, operators, mechanics are considered in this class.

(c) Semi-skilled: The category includes helpers, cleaners, pump and laboratory attendants, wiremen.

(d) Unskilled: Workers not requiring skill but involving only labour, engaged in carrying mortar and concrete, earthwork, loading, unloading operations, water-sprinklers and water-bearers are considered as unskilled labourers.

2.08 In Irrigation & Power Projects, the labour or human element may vary between 40 to 70 per cent depending on the work and degree of mechanisation. The labour element includes supervisory staff. However, the bulk of the labour employed is unskilled. The output of the skilled and unskilled labour for the type work done based on the available data of on going projects in 12 States is summarised and given at Annex.I. The Indian Standard Institution has published coefficients for 14 major items of building work on basis of scientific studies carried out by Central Building Research Institute. A few of these relevant to River Valley Projects alongwith labour output constants fixed for Employment Guarantee scheme of Maharashtra are also abstracted for general guidelines. "The information of the output is based on the data made available by various States. It is felt that there may be some inconsistencies. It will be observed that variation in the output as reported is rather wide, the variation within the State is also high. Even if the wage levels, as prevailing in the different states, are considered, the unit cost rate may not be comparable. The information may, therefore, be used for general guidance. The users are, therefore, advised to conduct time and motion studies to decide norms for their type of labour and conditions".

2.09 It is interesting to note that there is wide variation in output from region to region. This is essentially due to varying productivity of labour, their working methods difference in tools engaged, climatic conditions and to some extent varying specifications. A careful and systematic analysis of all these factors could provide a valuable subject for research. This research study could perhaps be undertaken by Department itself or the department may get it done through National Council or other competent organisations.

Masonry:

2.10 From the above available data summarised in Annex.I, the output per shift on stone-masonry varies 0.25 cum. to 4 cum but the normal output can be taken as 1 to 2 cum per 8 hours shift. The progress is dependent on the type of masonry and dressing requirements.

The brick masonry output varies from lowest figure of 0.3 cum., to highest of 5.0 cum., in 8 hours. The general output can be 1½ cum per mason.

Earthwork:

2.11 In ordinary earthwork the output per a normal young labour can be taken as 1 cum., to 4 cum. in 8 hours. Only in Rajasthan, the figures obtained were high as they are grouped from output of 5 labourers and a camel cart. The standard output in soils can be 2 to 3 cum per man shift of 8 hours. In soft rock, it varies from 0.3 to 2.0 cum. and in hard rock

as 0:2 to 1 cum of man shift. The output depends upon climate, nature of soil and lift and lead involved, and environments.

Forecast of labour requirement:

2.12 On most of the river valley projects, which were on going in different States during 1976-77, it has been observed that labour outlay is generally of the order of 30%. Thus out of every Rs. 100 lakhs outlay Rs. 30/- lakhs goes to labour. If we take Rs. 10/- as an average man-day wage, the Mandays needed for Rs. 100/- lakhs investment works out to 3,00,000; and considering the working days for River Valley projects as 200 days, the number of persons employed on an average works out to 1500 men. The ratio of skilled workers to unskilled workers generally comes to 1 to 2.5. The peak labour strength is noticed to be generally 25% more. The labour requirement indicated above is under the present degree of mechanisation and would reduce to the extent mechanisation as well as labour efficiency increases. The requirement of labour is expected to almost double as compared to 1979-80 level, by 84-85, when the outlay would be of the order of Rs. 2347/- crores. The assessment of annual labour required then is about 3.51 million on average and 4.39 million at peak.

2.13 The Statewise details of requirement of labour is given in Table I below:-

Name of State	Estimate for whole plan (1980-85) (Rs.crores)	Expected annual estimate towards the end of plan (Rs. crores)	Average labour required
1. Andhra Pradesh	988	239	3.58
2. Assam	90	24	0.36
3. Bihar	1045	266	3.99
4. Gujarat	710	146	2.18
5. Haryana	403	94	1.41
6. Himachal Pradesh	12	3	0.04
7. Jammu & Kashmir	97	25	0.37
8. Karnataka	508	121	1.81
9. Kerala	256	55	0.83
10. Madhya Pradesh	961	245	3.67
11. Maharashtra	1251	299	4.48
12. Manipur	42	10	0.15
13. Orissa	496	127	1.90
14. Punjab	306	72	1.08
15. Rajasthan	533	127	1.90
16. Tamil Nadu	153	35	0.52
17. Tripura	19	6	0.09
18. Uttar Pradesh	1410	354	5.31
19. West Bengal	273	68	1.02
20. Union Territory	40	8	0.12
21. Central Sector	95	23	0.34
Total:	9688	2347	35.15

AVAILABILITY OF LABOUR

2.14 India has a large geographical boundary, in both N-S and W-E directions. The administration of country is run through Central Government and other 22 States. The river valley Projects of Major/ Medium Irrigation Constitute a significant part of our development plans. They are located in rural areas and are fairly wide spreaded. These projects might be capital intensive or labour intensive or a combination of both.

2.15 The availability of labour is required to be examined carefully before embarking upon the implementation. There may be an abundant supply of labour in a particular area; but whether it can be attracted to civil construction during the periods, when activity is at peak,cannot be taken as granted. Ours is basically agricultural labour. In our country, the unskilled labourers are mainly available in Orissa, Bihar, Andhra Pradesh, Rajasthan and Maharashtra partly. These areas which are rich in labour cater to the major requirements of concentrated activities. These are supplemented by local labour. On scattered work the main labour force is of scattered labour. Their availability is widely fluctuating depending on the demands of Agriculture. Festivals also influence their availability. Even in the States where particular trades are predominent, shortages still occur, as they move out to other States where wage structure is better. The availability of labour again depends on the total volume of work undertaken in the State and in the country as a whole. Since there is no proper assessment made of total skills available in different parts of the country shortages do occur, affecting the execution of projects.

2.16 The Andhra Pradesh labour is good at quarrying operations, and masonry work, while that from Orissa, is expert at excavation both open and underground like tunnelling, mining etc. The Khandeshi labour from Maharashtra is good at transport jobs and masonry while that of Kerala is good at erection works. Rajasthani labourer dominate for work of excavation in arid regions, while that of Punjab, Haryana indicates expertise in mechanical fields and carpentry jobs. The Saurashtra labour in Gujarat has inclination on excavation of earthwork only although small proportion is suited to laying masonry.

2.17 The data available on the employment aspect of construction is scanty. The one comprehensive sources which gives some idea of employment in construction activity is the decennial census of population. As per 1951 census, out of 139.4 million Workers about 1.3 million (0.83%) are in construction activity. The figures of 1961 are registered as 187 million workers, with 2.1 million (1.1%) in construction field. The last figures of 1971 census is 1.23 per cent in construction field.

2.18 From the general studies, made regarding the overall situation of availability of labour and its requirement, the States can be classified in three broad groups as :-

a) Labour-surplus States,
b) Labour-self-sufficient States, and lastly
c) Labour-deficient States as under:-

a) Labour Surplus States:

These are:-

i) Orissa
ii) Rajasthan
iii) Madhya Pradesh (Chattisgarh there being lesser agricultural activity)

b) Labour self-sufficient:

These are:-

i) Andhra Pradesh (Palmori labour of Mehboob Nagar Distt. for earthwork)
ii) West Bengal
iii) Uttar Pradesh
iv) Tamil Nadu
v) Bihar
vi) Karnataka, etc.

c) Labour deficient States:

These are:-

i) Gujarat
ii) Maharashtra
iii) Punjab
iv) Haryana
v) Jammu & Kashmir

PRACTICES OF LABOUR RECRUITMENT:

2.19 Limited facilities of labour recruitment on systematic basis exists today and bulk force has to be recruited by individual efforts.

2.20 The supervisory labour for departmental work is employed through employment exchange. The unskilled category of labour is generally employed locally on daily basis on Nominal Muster Rolls or on taskwork or piece work basis. The skilled and semi-skilled are either employed on

monthly basis through employment exchange or on daily on Nominal Muster Rolls. In West Bengal, all categories of the labour are recruited through employment exchanges of the respective localities and from surplus staff of the Irrigation and Waterways Department. In Maharashtra an Employment Guarantee Scheme was introduced in March, 1972,restricted to minor Irrigation Works. Since July 1975 this covers the major and medium irrigation projects. The labour to various projects is supplied through the District Collector.

2.21 The Contract labour is recruited by the Contractor's themselves. In some cases they sub-let the works to sub-contractors and petty contractors. The payment to labourers in such cases is made as per their work, and is recruited locally or from outside on the basis of their experience.

2.22 The Contractors generally import labour from outside as the local labour has tendency to periodically return home for festivals, marriages, agricultural operations etc. The Orissa State has enacted the Orissa Dadan Labour (Control and Regulation) Act, 1975 which helps labour recruitment through authorised channels. This ensures better conditions to the labour. The Employment Guarantee Scheme of Maharashtra is a step to ensure employment and service conditions within the State. The Orissa Dadan Labour (Control and Regulation) Act, 1975 and the Employment Guarantee Scheme of Maharashtra are kept at Annex. II & III. The Government of Gujarat has a scheme of Right to work and the details are given in Annex.IV.

The Bihar State has also a system of labour recruitment through Bureau run by Government. This is similar to the Orissa Dadan Act., 1975 Scheme. The labourers are insured under group Insurance by Bureau and they are to be paid a single fare to work site and seven days wages for settling.

WAGES AND OTHER INCENTIVES:

2.23 The workers demand for advance for recruitment. They mainly cover the travel expenses and expenditure on establishing their camps on project sites. They also keep some cash provision for their family members who are left behind in native place. The other incentives required to be offered are hutments, free water supply, free medical facilities, subsidised food-grains, tools and plants, entertainment and weekly or fortnightly off-days. Free transport to site from camps is also offered by some contractors. Some of these facilities and privileges are covered in the various statutory provisions.

2.24 The wage structure of the construction workers, particularly on river valley projects is lower than that of organised Industrial Labourers. The construction workers, particularly the unskilled which form the major

part is drawn from Agricultural Sector. The construction equipment on Projects, are now getting sophisticated but the living and working conditions on project are severe. Therefore, wages are getting raised.

2.25 One of the most important aspect that needs attention is the wage structure and facilities to be provided at the project. These have to be clearly laid down before project starts, as it will envolve financial commitments. There can not be different wages for different sections of workers performing the same task. The contractor is expected to follow fair wages. What is a fair wage is not defined. The provision of the Contract-Labour (Regulation and Abolition) Act lays more responsibility on the project authorities, who as a principal employer, has to specify the wage structure to be paid.

The skilled workers who are employed in industry are entitled to other benefits, as overtime, paid weekly holiday and national holidays, casual leave and earned leave benefits. They also get gratuity and provident fund facilities. Their employment opportunities in urban areas are also better. Therefore, the skilled worker if required to work on project sites is often offered higher wages and better service conditions. The wage cost, therefore, works out to 70 to 100 per cent of cash wage rates, vide Annex.V. Their direct payments are also much in excess of provisions of Minimum Wages Act.

2.26 The labour is engaged on works on one of the following systems:-

a) Daily Wages,
b) Job work or task work,
c) Piece-work,
d) Commission basis,
e) Land Army.

2.27 In the daily wages system, the payment is made under provisions of the Minimum Wages Act and has no relevance to the output. This is, therefore, less productive and is generally restricted to odd jobs. The job work system of working is an improvement on the daily wages system where the wages are tied upto production which provides incentive to work. This again is suitable only for jobs involving direct employment of labour. The piece-work system of working and the Commission basis of working are intermediate between direct employment of labour and contract system of work. It does not involve direct employment of labour. As the payment is on the basis of unit rates, the labour efficiency is high. Size of piece-works being relatively small a group of families/ villages, having mainly their own labour force, takes works on piece work. The cost of work done on this system is relatively less as the middle man is partially eliminated. In the Land Army System of working which is of recent origin, the work is done by a group of workers through the Land Army Set-up under statutory provisions.

LABOUR HABITS:

2.28 Work Habits: Each labour group has different work habits. For labour coming from Agriculture sector, the working season is restricted to Non-Agricultural period only. Some labour groups prefer weekly holidays, while others observe only one holiday in a fortnight. In working also, some labour force prefer to work from early morning to afternoon, while some work from dawn to dusk. The Palmoori labour works for a fixed number of months and then returns to their home town.

2.29 Food Habits: The nation is having different cultural and living habits in almost all States. Therefore, the food habits also differ widely from State to State. Even in one State, whether small or big, the food habits differ considerably from district to district. Though the labourers are employed anywhere from one end to another end of State one State to another State on account of employment through their intermediaries, they continue to have their own food habits. They do not come forward, to accept the changes if compelled, even after their prolonged working in different areas other than from which they hail. However, recently due to the Government of India policy to pay part wages in form of "Wheat" under 'Food for Work Programme' the labourers have been acclimatising to wheat instead of their food habits, like those from South India prefer 'Rice' to Wheat, or those who come from Maharashtra prefer 'Millo' to 'Wheat'. Community kitchens are popular with some labour, but these are exceptions as most of the labour manages family kitchen. Worker likes to cook his own food and wants to have his own fire place for cooking. Even the running of Community messes or Canteens is not easily possible as these have to suit vegetarian and non-vegetarian, fish eating different financial status etc.

This raises the problem of providing kitchen place to each worker. The workers particularly the skilled category always insist on getting family accommodation on works which are for more than one or two year's duration.

2.30 All labourers are not suitable for all types of labour jobs, and, therefore, versatile labour force is not possible to be recruited. There are, however, labour groups which are either available for more than one item of work, say Transport of Excavation, or Concreting or Motor manufacturing. At times, they can be trained for other suitable jobs. The labourers from Andhra or Orissa may adopt different tools and implements of excavation and transport facilities. This is required to be borne in mind, at the time of drawing a blue-print of implementation schedule of Major/Medium schemes.

OUTLOOK OF CONSTRUCTION WORKERS:

2.31 It could be said that construction workers, particularly those working on the projects have rare qualities. They take pride in the works

as they see that they are building some thing for the country. Their way of thinking is usually service and sacrifice oriented. They have come to odd places away from their homes, to places where the land is virgin, devoid of even minimum facilities available in towns or cities.

2.32 Job satisfaction of man-power should be one of the aims of construction management. Since this leads to a greater degree of participation and involvement which is a pre-requisite for better performance. These should include adequate pay, good working conditions, safety, insurances against injury and risks and human approach to their problems. If this is not achieved the assumption that labour intensive work is economical and also leads to betterment of living conditions of people will not be achieved. Ultimate results and benefits from the project also will not accure in time.

So, how best to take care of the out look and motivate them is a factor that needs orientation and training among construction engineers both from the department and construction agencies.

LABOUR LAWS:

2.33 There is no comprehensive labour legislation to govern and control the over all aspects of construction employment and the worker, particularly so on Irrigation and Power Projects. There are as many as 15 Laws and Acts which are made applicable on construction site. They are State or Central Acts. They are enumerated briefly below:-

1) The Workman's Compensation Act, 1923:

An act to provide for the payment of compensation by certain class of employees to their workmen for injury by accident.

2) The Payment of Wages Act 1936:

The act to regulate the payment of wages to certain classes of persons employed in Industry.

3) The Industrial Employment(Standing Orders) Act, 1946:

An act to require employers in Industrial Establishment formally to define conditions of employment under them.

4) The Industrial Dispute Act, 1947:

An act to make provision for the investigations and in settlement of Industrial disputes and for certain other purposes.

5) The Factories Act, 1948:

An act to consolidate and amend the law regulating labour in factories.

6) The Minimum Wages Act, 1948:

The act to provide for fixing minimum rates of wages in certain employments.

7) The Employees Provident Funds Act, 1952:

The Act to provide for the Institution of Provident Fund for employees in factories and other establishments.

8) The Mines Act, 1952:

An act to amend and consolidate the law relating to the regulation of labour and safety.

9) The Employment Exchange Act, 1958:
(Compulsory Notification of Vacancies).

An act requiring the employer to notify vacancies in certain categories and to call for registered candidates from the Local Employment Exchange.

10) The Apprentices Act, 1961:

An act to provide for the regulation and control of training of apprentices in trades and for matters connected therewith.

11) The Motor Transport Workers Act, 1961:

An act to provide for the welfare of Motor Transport Workers and to regulate the conditions of their work.

12) The Personal Injuries (Compensation Insurance) Act, 1963:

An act to impose on employers a liability to pay compensation to workmen, sustaining personal injuries, and to provide for the insurance of.

13) The Payment of Bonus Act, 1966:

An act to provide for payment of Bonus to persons employed in certain establishment and in matters connected therewith.

14) The Contract labour (Regulation and Abolition) Act,1970:

An act to regulate the employment of contract labour in certain establishments and to provide for the abolition in certain circumstances and for matters connected therewith.

15) The Payment of Gratuity Act, 1972:

An act to provide for a scheme for the payment of gratuity to employees engaged in Workshops, Mines, Shops other establishment and matters related to them.

2.34 In addition to these laws, some other laws are also in force in various states. For example U.P. has following Acts:

i) The U.P. Industrial Dispute Act, 1947
ii) The Uttar Pradesh Dookan Aur Vanijya Adhisthan Adhiniyam, 1962.
iii) The Employment of Childrens Act, 1938.

2.35 When all Laws and Acts are made applicable on Project sites, it is likely to result into confusion and conflict. The labour officers are normally accustomed to enforcing labour laws, disciplinary actions under Industrial Dispute Act, etc., and not to solve the conflicts that arise by taking a human approach to problem. There is tendency to get best out of all laws and Acts. The effects may be on either side. Even the construction agency may exploit fully the complexity of labour Acts and Laws,, to their advantage. Hence it is very necessary that comprehensive legislation applicable to Irrigation and power Project Construction work are enacted, taking into consideration that construction work is basically a contract form of work, seasonal, temporary and mobile with no security even for the construction agency, whether private,public or Government labour intensive, work load varying, and in remote places from Urban areas.

RIGHT TO WORK:

2.36 In the Gujarat State, all workers either skilled, semi-skilled or unskilled have right to get employment on the schemes which can generate utilisation of sufficient man-power. The local labour must be employed first to earn the bread of family. The State Government has formulated standards for this and keeps a close watch on the progress made through such employment.

Employment Guarantee Scheme:

2.37 This scheme has been formulated by Government of Maharashtra in March,1972. This has been found very useful in ensuring work and proper wage return to able workers and improving the financial stability of employed or under-employed people of rural areas. This scheme has been developed subsequent to closure of scarcity works. The unskilled labourers can get employment under this scheme.

LABOUR OFFICER:

2.38 For the problems related to labourers, regarding their interest and continuous work, an exclusive labour officer should be employed on each project site. The labour officer can help in early settlement of problems of labour. He can also keep records of various types of labour force available on site with their preference of work and wage rates.

PROBLEMS OF LABOUR MOBILISATION:

2.39 Seasonal Availability: The major and medium irrigation projects and power projects have their own special complexity being seasonal, casual and uncertain of continuous employment. The volume with intensity depends on vagaries of nature, rains, floods in river etc. On dam works, the work almost comes to stand-still during the months of July to September. In tunnel works, and underground power houses, work may go on but problems of pumping, land slides may bring closure of works. Also each activity has different periods of work. Therefore, for Project Workers there is a constant change of place of work. Every one has to move out after the construction work is over. This has inherent problems of housing, education, environments and family problems. Likewise agricultural labour shifts to farms during periods of agriculture operations which conflict with the working period on construction jobs. Even in agriculture, the requirement is varying and highly fluctuating resulting in difficult situation for planning the labour recruitment for construction activity. Further the local labour availability suddenly drops during festivals and marriage season.

2.40 Imported labour force from other States, at times does not get settled at certain sites, on account of their food habits or climatic changes, which are difficult to adjust. Frequent cold weather or snow fall are difficult for labourers from Southern States. The new law controlling the movement of labour from State to State has created some further problems.

2.41 Competing demands: Due to shifting tendencies of the labour, the contractors at times has to keep an organised labour force of imported labour, to keep the tempo of work. In such situation, imparting training becomes necessary. The demands for local and normal activities of the area receive higher priority from labour as they are used to such type of working and that such type of work would be available for years to come. The requirement of the construction activity therefore receives lower priority even if better wages and working facilities are offered. Only when local employment in the normal fields of activities is not possible, the people have tendency to come for the construction activity. They some times demand preference in employment in areas of activities for which they do not have required capabilities. The solution to such situation

lies in creating training facilities.

WORK FOR THE LOCAL AND DISPLACED PERSONS:

2.42 In almost all projects big or small, the preferences are of giving employment to local people and people who have been displaced due to their lands or houses being acquired for the project. There is no proper definition. of who is local. Even for "displaced", persons there is no proper definition. These create problems just at the start and some compromises are made which affect the execution of the project in cost, time and quality. How to tackle this very important matter needs careful attention at socio-political level.

ORGANISATION AND FACILITIES:

2.43 Once we consider a larger extent of labour utilisation on River Valley Projects and plan for more labour intensive and less capital intensive methods, a thought will have to be given to the man-management problems at all levels. On major projects, a large fleet of skilled, semi-skilled and unskilled workers are settled for construction period. There will be many connected problems, regarding their health facilities, contractural obligations and enactment of labour acts. The most difficult problem is to control and motivate the man-power or the Human Resources. The Engineers who take work from the workers have to understand the human behaviour and adjust. The Engineers are tought more to deal with materials and machinery or design aspects and not human beings. The workers expect the Engineer or his subordinate who takes works from him to look after his interest and welfare. There is a need for formal training of Technical Officers in Labour Management and the Labour Laws as they are ultimately responsible for taking the work and there should be welfare officers, on the project, appointed to look after the welfare of the workers. It has also to be appreciated that there is no system for making adjustment in the project estimates to take care of the infrastructures needed for adopting labour intensive system of work.

2.44 To keep the labour contended, it is necessary that basic amenities of life are provided in the form of well laid labour camps, good water supply, lighting, sanitation, shopping facilities and dispensary for medical aids; craddle sheds on the work site for small kids. It is not enough just to stipulate in the contract what facilities the construction agency has to give to the workers but it has to be enforced as it has an important bearing on management problem.

2.45 The problems of wages, irregularities in payment and compensation in case of injuries or fatal accidents needs to be attended promptly to redress the grievancies of workers and keep them contended.

CONTINUOUS EMPLOYMENT:

2.46 The working seasons and months when the labour strength reaches its peak, differ from State to State. From study made by the Khare Committee, regarding the working and non-working seasons, it is found that in Southern Region of India has two seasons, one of about 150 days from January to June and other of about 100 days between August to November. The labour strength required in shorter session thus gets/refused to 2/3. In northern States of Rajasthan and U.P.,Punjab,Haryana,the working season is from November to June, but with a down rate in March, on account of harvest season, marriages and Baisakhi. The peak demand comes in December to February. In Gujarat, the working season is from November to June with peaks in January and April. In Eastern regions, it is from November to middle of June with peak in March, Thus the projects do not provide full time employment. Some times, the labour remains idle due to:-

i) Short supply of construction materials;
ii) Break-down of machinery and power; and
iii) Spreading of epidemic.

2.47 The continuity of labour is as important aspect for two reasons:

i) The Project implementation programme has to be planned accordingly; and

ii) Assurance of job to the labour.

The labours can be given continuous work by reserving some alternative work both for off-peak period of working season as well as for non-working season. The works like excavation of canals, earthwork of saddles on higher locations, pitching, extraction of rubble,turfing or even masonry work on flanks can be planned. Such alternative employment could provide work for sufficient labour force during monsoon. This labour could incidentally be available to fight against flood hazards Providing them continuous work, saves on journey-fares to their home towns and ensures availability of labour for next working season.

2.48 Alternatively during non-working periods, labourers could be paid adequate compensation for lay off or subsistence wages in the form of food and a fraction of their daily wage rate. Even they can be employed to other jobs, which may result in higher cost of production.

2.49 During consturction stage a large force skilled and unskilled labour gets trained. This type of labour is generally in short supply. We can, therefore, ill afford to loose them. Soto provide them Jobs on completion of projects is in the interest of the work as well as workers. For various reasons, there is resistance to mobility and, therefore,

attempts need to be made to accommodate them on projects within the State. Second preference would be for providing Jobs in other State. At the moment no machinery exists at the level of State or Centre to keep record of availability of such labour and to organise their movements from project to project. It is, therefore, suggested that at State level a cell may be maintained to register them and organise their movement on completion of project. A similar cell at Centre, preferably in the Central Water Commission, can look after similar functions for inter-state movements and registration.

MECHANISATION:

2.50 The rate of progress required for some jobs needs mechanisation of the effort. Further there are such of jobs, like concrete dam, rock fill dam, high earth dams, which can be done only by deploying mechinery. Mechanisation is thus inevitable in certain fields of activities as manual labour is inevitable in certain areas of activity. Only such jobs where both are suitable the choice has to be made by considering various factors such as rate of progress required, cost of production by each method, need for providing employment.

2.51 It also needs to be appreciated that machinery needs high investment. Large inventory is required. Trained operators Mechanics and Workshop Personnel are required for proper maintenance and repairs of the machinery. These are in short supply. None of these workers can be had on seasonal or casual basis, the component of idle wages paid to these skilled workers is considerable. Multi-trade training may bring down the cost to a certain extent. Training programmes are, therefore, required to be arranged. All these factors have to be considered in decision making regarding choice of construction technology.

2.52 Availability of labour in general is satisfactory. The main problem is that the labour is not available when required and where required and of the type required. Effective steps to ensure this would help not only in providing continued employment but also help keeping the costs low.

2.53 Careful blending of use of labour and machinery has been found useful in cutting down the costs and increasing rate of production. Particularly if intermediate tools are developed to suit to the labour working practices and careful blending of such tools and machinery with labour intensive construction techniques, the results could be very encouraging.

2.54 The strategy of implementation could be as under:

a) Modernisation to be done for jobs where it is inevitable and

where the job can not be done by manual labour and when labour is not available, it can not be imported easily or where labour intensive methods cost exceeds mechanised cost by more than 10%.

b) Labour to be used for jobs where labour fluctuations can be permitted.

c) Combination of labour and machinery to be resorted to, where feasible, for cutting down time and cost.

d) Where time and cost constrains are not very restrictive, preference is to be given to labour intensive methods.

e) Where intensities or value of work per day are heavy, mechanisation may have to be adopted.

BALANCE BETWEEN LABOUR AND MECHANISATION:

2.55 The degree of mechanisation is both a national issue and the one that has to be faced by Construction Projects Planners and engineers. Thus, the contractor and the engineer responsible for the execution of the project should decide on the best assignment of jobs to skilled and unskilled workers and equipment. This needs proper training orientation.

LABOUR INTENSIVE PROJECTS:

2.56 The following items of works are generally recommended by various States to be taken as labour intensive.

i) Earthwork of cut-off trench and earthwork of small dams involving a total earthwork of 1.50 M.Cum.

ii) Stone masonry dam having 2 M. cum. of masonry and ht., upto 40 m.

iii) All pitching and rock toe work.

iv) Concrete work of lower heights involving lifts upto 10 m.

v) Canal earthwork and lining having a bed width upto 4 meters and normal depth of cut upto 6 m.

vi) Distribution system of projects, involving a command upto 8000 hectares.

vii) All approach roads, including C.D.Works.

2.57 The construction methods presently in vague on Irrigation Projects for major items of work such as earthwork, foundations of dam, treatment of foundation, masonry work, concrete work and gates and hoisting arrangements and canal systems including C.D. works are as under:-

a) Earth-work

The earthwork is generally done by:-

i) Manual labour

ii) Deploying manual labour and transportation by donkeys

iii) By excavation through manual labour and transportation by trucks

iv) Excavation of earthwork, rock, and disposal through trolley

v) Earthwork by means of crawler, tractors scrappers-self loading or pusher driven, and by draglines and shovels

b) Treatment of foundations:

Foundation treatment involves drilling and grouting procedures. The major work is conducted through mechanised process:

c) Masonry Dam:

The masonry work of dam can generally be done:

i) By manual labour, employing machine mixing of mortar, but lifting stones, manually. The limitation in lift is about 10 meters, though higher lifts have been negotiated in some cases.

or ii) By mechanised means of lifting stones as well as mortar as done in Nagarjunasagar.

d) Concrete Dam:

All concrete dams are done by mechanised means of concrete mixing and placement and curing by labour force.

TOOLS INTERMEDIATE TECHNOLOGY:

2.58 The labour intensive projects have slow progress due to limitations of output. With the express need of early benefits to be achieved as far as possible all out efforts should be made to supplement the works by capital intensive methods. By developing intermediate tools

and using them in combination with labour, there could be reduction in cost and saving in time. Use of Builders hoists, conveyor belts, winches etc., where addition of these would improve productivity, safety, avoid tedious and strenuous works involved in lift, be considered.

CONCLUSIONS:

LABOUR INTENSIVE TECHNOLOGY:

2.59 In the next five years (1980-85) about 200 major schemes and 400 to 500 medium irrigation schemes would be implemented, for the creation of potential of 7.5 m.ha. The unskilled labour force of 3.5 million on an average and 4.37 million for peak work-load is estimated to be employed for this herculean task. Most of the unskilled labour comes from Agriculture Sector; and is tied upto the land. The labour may be available to the large extent in adequate number; but at times when they are required during peak periods of working season, it may not be possible, to muster full strength on each and every river valley schemes. Therefore, a flexible approach to mechanisation as well as labour intensive technology on irrigation project, keeping in view the rate structure of the items, will have to be adopted.

2.60 Out of the expected capital outlay of Rs. 83,500/- million on the major-medium schemes in VIth Plan, about 67% of outlay i.e. Rs. 55,945/- million could be considered as labour intensive. Almost all canal works including their distribution systems and linings, construction colonies of the projects, approach roads, on-farm development works, drainage systems, improvement schemes should be covered as labour intensive schemes.

2.61 Regarding the headworks to be taken up as labour intensive schemes, factors like nature of work, target of completion, economic investment of equipment and their limitations as discussed earlier, and problem of management with skilled labour should be compared v/s availability of labour. The studies recently carried out by World Bank Team in India, Indonesia, Kenya and other countries indicate "Labour intensive methods are technically feasible for wide range of construction activities and can generally produce the same quantity of products as capital intensive methods".

The Labour productivity can be improved very significantly by introduction of certain organisational, management and mechanical improvement. With superior tools high incentives and good management labour productivitiy can be improved to the point that Labour Intensive methods can be fully competitive with equipment - intensive methods". The earth dams of small magnitude involving 1.50 M.Cum of earthwork or 30 m height for masonry dams of 30-40 m height should be planned as labour intensive works provided head load involved are less than 300 metres.

2.62 Advance planning for capital intensive major projects which are multipurpose, should be done at project approval stage, after accounting for the work possible to be done by labour intensive methods. It has to be appreciated that human element is essentially predominant in any labour intensive work. The labour intensive work could be undertaken by those who have multi-disciplinary training in behavioural and social sciences as well as in technology.

Blending of labour and machinery:

2.63 For head works, envisaging construction of masonry spillway and earth dam, or entire masonry dam, the masonry dam works could be planned as labour intensive if height of dam is limited say 30 - 40 m. hts.

2.64 Mechanisation:

a) Mechanisation for large concrete jobs is inevitable.

b) All earth dam involving placement of earth more than 1.50 M. cum., within a short span of 2 to 3 years, can be implemented through mechanisation, even if little costlier. The availability of skilled labour from completed project or under completion can be kept in mind at the time of planning for mechanisation. Even here use of higher transporting fleet like trucks and tippers if can be adopted. This would help in keeping the costs low.

LABOUR RECRUITMENT METHODS:

2.65 There exists various labour recruitment methods. Labour laws and acts are also many. Some unified labour recruitment methods and labour laws are desirable.

RECOMMENDATIONS FOR LABOUR WELFARE FACILITIES:

2.66 a) Strict enforcement of labour laws:

The provisions of local labour laws should be strictly enforced.

b) Adequate Housing:

Well planned labour camps with adequate floor space should be provided. To help in financing this investment, 75 to 80% of advance payment against completed residential labour should be permitted under the contract.

c) Water Supply:

Facilities of good drinking water should be ensured in labour camps.

d) Transport Facilities:

The Project authorities/contractors should provide free transport facilities to and from labour colonies to location of work.

e) Medical Facilities:

Medical facilities, with exclusive medical unit should be provided at the site of work.

f) Subsidised Rations:

Co-operative shops to supply subsidised food grains and dealing with other basic daily needs, should be organised in the labour colonies.

g) Check on Epidemics:

Suitable steps should be taken up for exercising check on spread of epidemics like Malaria, Typhoid, Cholera etc.

h) Continuity of labour:

Perspective planning should be made for continuous employment of labour on completion of one project to other projects to come up. The slack seasons, (Non-working season) alternative works should be reserved for providing seasonal employment like metal breaking, turfing, pitching and canal excavations even if they are costlier. Handicrafts could also be considered.

i) Entertainment:

Suitable entertainment shows, or cinemas should be organised.

j) Schools:

Education programme or schooling facilities be provided by Project authorities/contractors to the children between 7 to 15 years.

k) Training:

Suitable training programme should be organised to raise the standard of productivity. The training can be (i) on Job training (ii) Institutional training. There are about 300 Industrial training Centres all over the country. Response for institutional training in construction activity in trades like Concrete, Viberator, Barbending, Masonry is rather poor. Much of the effort and bad work could be avoided if trained personnel in the trades are available. There has to be, therefore, on Job training effort on the project according to the need of work. Some expenditure shall be earmarked in large projects for training labour in high productive techniques and introduction of high production tools.

2.67 To take advantage of the trained labour force, it is considered desirable to introduce system of registration of skilled workers. On completion of a project, a list of such workers likely to be surplus may be circulated to the projects within the State and to other projects in the country so that such persons which remain unabsorbed within the State can get absorbed on projects outside the State.

III. STANDARD DESCRIPTION OF MAIN ITEMS OF UNIVERSAL NATURE IN RATIONALISED UNITS

CHAPTER III

STANDARD DESCRIPTION OF MAIN ITEMS OF UNIVERSAL IN RATIONALISED UNITS.

3.0 NECESSITY AND LIMITATION:

3.01 A multipurpose river valley project entails a large number of items for execution. Irrespective to the type of project, whether it is a storage, diversion or run of the river scheme there are certain items which are common in nature and are encountered in each type of project. In addition there are certain particular items of work of special nature and these vary from project to project. The bulk of the items, which largely constitutes the major portion of the project estimate, is of universal nature. Therefore, these items which are of universal nature for easy identification, need correct description of their type, along with rationalised units.

3.02 In the contract documents if all the items are correctly defined there are little chances of controversy with the contracting agency in interpreting of the items and their payment. The controversy arises only in the event of ambiguous nature of items or when there is no item at all in the contract. To correctly categorise the item of work under execution, a standard description of various items along with their units in which the work is to be measured is, therefore, imperative. This will enable easy identification of one item of work as distinct from another one. It is neither possible nor practicable to treat each and every item, which will or likely to be encountered during the course of execution as Universal, because there are so many off number of items whose specifications vary greatly from project to project, depending upon the nature of the job and the availability of the construction materials. Such items will have to be paid according to rates prevalent for that item similar in nature on other projects or decided by inviting the tenders if the magnitude of the item is big.

IDENTIFICATION OF ITEMS:

3.03 Based on data received from the various authorities some 44 items were tentatively selected for framing the Standard description along with rationalised unit. The list being not very exhaustive, has been further amended to include a few mere items which are normally required to be executed particularly for run off the river schemes. A large number of multipurpose river valley projects of Ganga and Yamuna valley, which are under execution or in Stage of planning, have, therefore, been studied so

as to include all items of universal nature as far as possible. While laying the standards the nomenclature has been made brief, leaving other relevant information to be covered by the specifications.

RATIONALISED UNIT:

3.04 In the units of measure for payment a large diversity exists at present according to local practices on works of River Valley Projects. For the gates of barrages, spillways and sluices the unit measure specified is per set per Nos., per square metre or per ton. Grouting is another important item where different practices are followed. On some works of the River Valley Projects, measurement for payment is made on the basis of total cubic metre of fluid grout mixture injected in all holes, regardless of grout mixture used. The unit of measure for Metal Seals is either per Metre or by Weight. While computing the quantity of water stops no separate payment is however made for laps, brazing, punching and bending etc. For such items, which are common to number of projects, some standardization is necessary.

3.05 The gates for barrages, spillways, sluices, which are normally custom made according to specific designs and conforming to the fabrication drawings prepared by the manufacturer's, the unit of measure could be a set, or number or even area; depending on the supplies/manufacturer's quotation and the bid price accepted. To specify payment on the basis of rate per ton of weight would be combersome and to some extent impracticable. The unit of measure for these items at S.No. 41, 42 and 44 in Mt., is intended only for framing the project estimate.

3.06 The operation of grouting depends on the voids to be filled and it is customary to start grouting operation with thin grout and gradually thicken it. The measurement of all types of grouts as such should be on basis of weight of material in the grout actually forced into the holes. The units of measure for items at Sl. No. 21, 22, 37 and 38 has been suggested accordingly.

3.07 The supply of raw materials by the Market, for some of the items such as Metal Seals, is usually on basis of weight. The unit of measure for such items at Sl. No. 12(a) and 12(c) has been specified per "Kg" so as to bring it in line with unit of supply by Market, as in the case of gate. When the gauge of the material to be used and the dimensions are specified and are fixed it could be convenient to measure these by length of specified gauge and dimension in metres or in square metres.

3.08 The unit pf measure in 'Km' for items at Sl. No. (48)

Water Courses and Sl. No. (49) Distributaries is intended only for the purpose of framing project estimate. Even for this purpose the unit cost per km., will have to be determined considering combinations of various channel sections adopted for the project as the channel sections vary considerably even in the same project.

MAIN ITEMS OF UNIVERSAL NATURE

3.09 The Standard Description of the items of Universal Nature in Rationalised Units are given hereunder:-

Sl. No.	Items	Rationalised Unit
1.	Rock Excavation in foundation	Per Cum.
2.	Common Excavation in dams and barrages	Per Cum.
3.	Earth fill in Dam	Per Cum.
4.	Rock fill in dam	Per Cum.
5.	Inverted filter	Per Cum.
6.	Stone riprap or pitching	Per Cum.
7.	Stone masonry in hearting of dam	Per Cum.
8.	Face masonry 1:4 in dams	Per Cum.
9.	Mass concrete in dams (M-100)	Per Cum.
10. (i)	Concrete M-150 in spillways, dams bridge piers and intake	Per Cum.
(ii)	Concrete M-200 in dams and spillways	Per Cum.
(iii)	Concrete M-250 in dams, spillways and head works.	Per Cum.
11.	Mild steel reinforcement	Per Tonne
12.	Seals:	
(a)	Furnishing and installing copper seal	Per Kg.
(b)	Furnishing and installing ashphalt seal	Per R.M.

	(c) Furnishing and installing monel metal seal	Per Kg.
13.	Rock belt in tunnels	Per R.M.
14.	Pen Stocks liners	Per tonne.
15.	Rock Excavation in tunnels	Per Cum.
16.	Fabrication and erection of steel supports for underground excavation	Per tonne.
17.	Shotereting	Per Bag of 50 Kg of Cement Consumption.
18.	Dewatering of foundations	Per KWH Consumption
19.	Earth Work in lip cutting in bed and slope in all types of soils	Per Cum.
20.	Drilling Grout holes (a) Upto 5.0 M depth (b) More than 5.0 M depth	Per R.M.
21.	Grouting in dam/barrage foundation.	Per bag of 50 Kg of cement consumption
22.	Grouting in tunnels	Per bag of 50 Kg of cement consumption
23.	Granite setts	Per Cum.
24.	Boulder setts	Per Cum.
25.	Pumped concrete of specified grade in pen-stocks and surge shaft.	Per Cum.
26.	Coarse Aggregates	Per Cum.
27.	Sand (crushed)	Per Cum.
28.	Concrete in Power House Sub-structure	Per Cum.
29.	Concrete in Power House Super Structure	Per Cum.
30.	Structural steel work for Power House	M.T.
31.	Sheet piling	M. Tons

32.	Shaft Excavation	Per Cum.
33.	Canal Excavation	Per Cum.
34.	Tile lining in canals	Sq. M
35.	Concrete lining of canals (of specified thickness)	Sq. M
36.	Pressure relief valves	Nos.
37.	Bentonite Grouting	Per Kg of Bentonite Consumption.
38.	Chemical Grouting	Per Kg. of Chemical Consumption.
39.	Rock toe	Per Cum.
40.	Form work and shuttering (a) Plain (b) Curved	Sq. M
41.	Radial gates for spillway	M.T.
42.	Sluice gates for irrigation cutlets, tunnel intakes, draft tube gates.	M.T.
43.	Gantry Crane	According to specifications
44.	Barrage gates	M.T.
45.	Stoplog gates	M.T.
46.	Trash racks	M.T.
47.	Butterfly valves	Nos.
48.	Water courses (Sections to be specified)	Per Km.
49.	Distributories (Sections to be specified)	Per Km.
50.	Prestressed Anchors	Nos. (According to specifications)
51.	Furnishing and installing passenger elevator	Job/Number

52.	Construction of haul roads	Per Km.
53.	Construction of 6.1 m wide metalled Road	Per Km.
54.	Painting of liners	Sq. M
55.	False roofing	Sq. M (According to specifications).
56.	Concrete pre-trench for diaphragm Walls	Per R.M.
57.	Plastic concrete diaphragm wall	Per Cu. m

IV STANDARD SPECIFICATIONS IN CONSONANCE WITH INDIAN STANDARDS

CHAPTER IV

STANDARD SPECIFICATION IN CONSONANCE WITH INDIAN STANDARDS

4.0 STANDARD SPECIFICATION IN VOGUE IN STATES PRIOR TO INTRODUCTION OF INDIAN STANDARDS

4.0.1 Execution of public works is done both on contract and by deployment of departmental machinery and labour force. Works have to be executed as per pre-determined designs. Specifications of every component item of Work is an integral part of the design. Therefore, before execution is taken up writing out specifications of Work is essential, it may be for contract work or for departmental work. Specifications lay down the complete methodology of producing a finish product which should be according to the stipulated design. Specifications have, therefore, to cover the following items:

i. type and quality of materials going into production of an item,

ii. method of testing the quality of inputs,

iii. proportioning of various inputs,

iv. methodology of execution,

v. required strength of various components of the finished job,

vi. procedure of testing the strength/quality of various components of the finished job to ensure stipulated design.

4.0.2 Prior to independence (1947) various Central and State construction agencies had prepared their own specifications for execution of their Works. To name a few important ones these were M.E.S. Hand-book, Bombay P.W.D. Hand-book, Punjab, P.W.D. Specifications Indian Railway Code of practice, Indian Roads Congress Standards etc. Most of these specifications were based on the British model except that these were manual labour oriented because of very little mechanisation in civil engineering construction in the country, during that period. As far as the quality of materials and their testing procedures for quality and strength (covered under sub-paras i,ii, v and vi of para 4.0.1 above) the aforesaid specification referred to the following standards:-

i. British Standard Specifications: and codes of practices;

ii. American Society for Testing and Materials-designation (ASTM);

iii. American Concrete Institute Buildings regulations (ACI Codes).

WORK DONE BY I.S.I. ON THE SUBJECT:

4.0.3 In the year 1947, Indian Standards Institution was set up with the active support of industrial, scientific and technical organisations in the country. The aims and objects of the institute include preparation of standards relating to products, commodities, materials and processes. The Indian Standards Institution has set up a large number of Technical Committees appointed by the 11 Divisional Councils of the Institution dealing with various disciplines. The Civil Engineering Division Council is entrusted with the formulation of Standards for civil engineering works including River Valley Projects. On these Committees, experts are taken representing various interests such as Producers, Consumers, Technologists, Research and Testing Organisations, both in public and private sectors. These experts work in honorary capacity and evolve National Standards through consensus of opinion. The ISI have so for published 1400 standards pertaining to civil engineering and building works. The Central Government departments dealing with Civil Engineering construction and all the State Governments have adopted the Indian Standards. Out of the above 200 standards pertain specifically to the various aspects of design construction etc., of River Valley Projects.

DATA BASE FOR I.S.I. STANDARDS:

4.0.4 The Indian Standards Institute has in each of the published standards, indicated the basis on which the specifications have been formulated. They have taken into consideration the views of experts, testing authorities, consumers and technologists and have related the standards to the practices followed in the country and have also derived valuable assistance from the specifications for various projects involving similar items, prevalent in the country. They have also taken assistance from the British Standard specifications and American Specifications as well as specifications of Canadian, German and Australian bodies, U.S. Bureau of Reclamation, Tennessee valley authority etc.

EXTENT TO WHICH STATES/PROJECTS HAVE ADOPTED I.S.I. IN THEIR CONTRACTS:

4.0.5 A review of contract specifications for works adopted by various States so far shows that every State/project evolves its own specifications. The specifications so drafted, however, make a reference to the relevant Indian Standard in so far as the quality of various input like cement, sand, steel etc., is concerned. Though the Indian Standards have

brought out the standards regarding workmanship of many items connected with civil engineering items, the State/Projects, by and large at present do not adopt these in full. They, however, many a times take guidance from the description in such Indian Standards and modify the same to suit the requirement of a particular job, while drafting their own job specifications.

LIMITATION OF ADOPTING INDIAN STANDARDS IN CONTRACTS:

4.0.6 Various items, which the specifications are required to cover, are listed in para 4.0.1 of this Chapter. When these specifications are to be adopted in contracts, a very important aspect to be taken care of is that the specifications should be capable of one interpretation only so as to avoid any dispute between the parties to the contract. A study of various Indian Standards shows that:-

i) standards relating to specifications for input are definite:

ii) standards relating to testing of inputs and sampling of finished products are definite, but

iii) standards relating to construction methods usually stipulate that "the code is required to be supplemented by special instructions if any for each job".

4.0.7 It may be mentioned here that wherever Indian Standard Code of practices are available, which give detailed specification for workmanship, they should be incorporated in contract specifications, to the extent they are applicable to the item of work as in the process of formulation of standards a great deal of effort and work is done in codifying the specifications for work by consultation with all the important organisation, in the country. In some cases, although I.S.I. Standards are ideal, the type of construction material available locally particularly aggregates and soils may not strictly meet the ideal requirements. In such cases, it may be necessary to modify or /add a separate write-up, on specification.

4.0.8 It is thus seen that there is need to draft contract specifications for works wherein the construction methods specifications have to be related to each job. It would, however, be enough if Specifications so drafted, give only reference to the relevant Indian Standard in respect of the quality of inputs and methods of testing the inputs and sampling, instead of repeating the same.

LIST OF ITEMS FOR WHICH STANDARD CONTRACT SPECIFICATIONS NEED TO BE FORMULATED:

4.0.9 Just as the Indian Standards can not be uniformly adopted as contract specifications and the need of drafting separate specifications has been indicated in the foregoing paragraphs, it is felt that no uniform contract speficication, centrally drafted, can serve the purpose of every project, due to inherent variation from project to project as well as in local practices and availability of local materials required to be used to ensure economy in construction. It is, however, felt that in a large number of items connected with River Valley projects, a standard pattern of uniform contract specifications can be drawn up to remove the present inconsistency which many a times occur while drafting job specifications for each job. Such inconsistencies very often lead to dispute between the parties to the contract resulting in delay in execution of the work thus many times affecting the cost of work. Since the design practices within the country are fairly uniform, formulation of a uniform set of contract specifications clearly and unambiguously worked out, to enable proper implementation and quality control, by the authorities responsible for the same, without creating scope of dispute between the parties to the contract, appears feasible.

GUIDELINES FOR FRAMING SPECIFICATIONS OF TUNNELS

4.10 Great care and importance has to be given to formulating of specifications, taking into account the varied conditions under which these works have to be executed. The requirement of each item must be set out in clear terms in the specifications. The Indian Standards may have to be consulted in this respect, and all the salient points indicated in the relevant sections of the standards have to be incorporated to the extent they are applicable to the item of work. It may be mentioned here that for tunnels alone at present, Indian Standards Institution has published Indian Standard Codes of practice for Designs of Tunnels (IS:4880) and also Codes of practice for Construction of Tunnels (IS: 5878). The Indian Standard Institute has also published safety codes for tunnelling work and other allied items (IS:4756, IS: 4137 & IS: 4081). The codes of practice for design of tunnels cater to geometic design, hydraulic design, structural design of concrete lining in rock and soft strata and soils, tunnel, supports, and structural design of steel lining (in IS: 4880 Parts I to VII).

4.11 The Codes of Practice for construction of tunnels cover the (i) precision survey and layout (ii) drilling and blasting, (iii) ventilation, lighting, mucking and dewatering, (iv) tunnelling methods for steeply inclined tunnels and shafts, (v) underground excavation in soft strata, (vi) tunnel supports, (vii) concrete lining, (viii) steel lining and (ix) grouting. (In IS: 5878 Parts I to VII). The specifications and codes of practice published by ISI are periodically revised and up-dated, in keeping with the latest thinking on design and construction of tunnels, as applicable to Indian conditions.

4.12 The specifications for tunnels are also detailed in a number of contracts let out by various river valley projects all over India. These also cover the technical requirements of various aspects of tunnelling required to be constructed for the project in question.

4.13 In as much as the specifications for tunnels are concerned, the data given above can be relied upon to draft specifications for tunnels. It is a normal practice with the authorities drafting the specifications not to accept the responsibility for the geological data made by them, and insist on the contracting agency to cover all risks, or, in the alternative, to include the definition of likely strata to be encountered so much wide and all encompassing, and ask for a flat rate for any and all likely eventualities. This leads to speculation on the part of constructors about the likely eventualities, and results in a gamble and in many cases, unnecessary delays frictions between parties, wasteful costs and litigations. All this leads to delay in completing of projects resulting in indirect losses, and also increases the direct cost of construction. This is specially so in the tunnelling jobs to be done in the Himalayas.

4.14 In the advanced countries, this aspect is given its due importance. Extensive geological investigations are carried out, and the data made available from these is the basis of the contract, and for any variations encountered in actual execution, the contract provides for suitable compensation. The Committee of technical Officers have deliberated on the issue of changed conditions differing site conditions in their report, "Measures for improvement in Contract documents" - the extract of the recommendations are produced below so that for important works these could be available for guidance.

"River valley projects, Hydro Electric Projects and other similar major Projects are mostly located in difficult terrain involving complicated construction. It is observed that in spite of best efforts taken in making full investigation, often actual conditions such as, Geological, Hydrological etc., are some time quite different than what has been envisaged in the tender documents.

The Committee deliberated on this issue extensively and in depth Some members of the Committee were of the view that a clause catering to changed conditions as per draft below be included in the general conditions of contract. They also felt that in the absence of such a clause the arbitrators are liable to take a restricted view and even the entire claim on this aspect as non-arbitrable."

"If during the execution of the works the contractor shall encounters substantial change in geological, hydrological and other similar conditions than what have been prescribed in the Tender or artificial obstructions, which conditions or obstructions would in his opinion not

have been reasonably foreseen by an experienced contractor, the contractor shall give written notice forthwith and submit his claim with full details which shall be considered by the Engineer-incharge on its merits".

The other view was that since there has to be always an agreement between the engineer-in-charge and the contractor about the changed conditions and in case of any difference in opinion about the same it can be taken care of under the clause "Settlement of disputes" and "arbitration".

The differing site condition clause as provided in the United States in their contracts, read as under:

a) The contractor shall promptly, and before such condition are disturbed notify the contracting officer in writing of:- (1) subsurface or latent physical conditions at the site differing materially from those indicated in his contract **or** (2) unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognised as inherent in work of the character provided for in this contract. The Contracting Officer shall promptly investigate the conditions and if he finds that such conditions do materially so differ and cause an increase or decrease in the contractor's cost of, or the time required for, performance of any part of the work under this contract, whether or not changed as a result of such conditions, an equitable adjustment shall be made and the contract modified in writing accordingly.

b) No claim of the Contractor under this clause shall be allowed unless the contractor has given the notice required in (a) above; provided, however, the time prescribed, therefore, may be extended by the Govt.,

c) No claim by the Contractor for an equitable adjustment hereunder shall be allowed if asserted after final payment under this contract.

Some members felt that probably the solution of this issue does not lie in the provision of "differing site conditions" clause but in the avoidance of disclaimers which are generally found in our contracts. It was decided that these discussions and views should be on the record in in the report so that for important works these could be available for guidance.

4.15 Although no set of specifications can be comprehensive and cover every likely eventuality likely to be encountered especially in underground works, it is suggested that the specifications may be drafted taking into

account the following:-

The work of tunnelling in to be split up into:-

a) Tunnelling in Rock Strata

i) in Homogeneous rock conditions,

ii) in Heterogeneous rock conditions,

iii) in Heterogeneous rock conditions subjected to high water pressures.

b) Tunnelling in soft strata, including clay, sand, alluvial or terrace deposits with or without water surcharged condition, flowing ground etc.

The type of tunnelling required to be carried out and which is best suited to site conditions will depend on the results of both physical, geological and geotechnical investigations.

4.16 The mode of excavation and the type of equipment to be deployed, both indigenous and imported, will depend on .-

i) the site conditions,

ii) the time available for completion,

iii) The availability of equipment,

iv) the economics of using the equipment vis-a-vis the utilisation on the project and its adaptability to other job conditions,

v) the availability of suitable trained personnel.

Ground Supports:

4.17 The type of treatment required for supporting the ground may include:-

i) consolidation in advance to make the ground competent for tunnelling trough it,

ii) consolidation of ground after boring the tunnel,

iii) supporting the excavated section by means of -

a) shotcreting with or without wiremesh,

b) temporary supports and rock bolting,

c) permanent supports, designed for varying rock conditions and loads,

d) forepoling by use of timber or steel sections.

This can be determined in advance based on the investigations carried out. Suitable resources required to be developed to cater to the requirement of supports can be defined at the planning stage.

4.18 Surveying & layout for tunnel and the accuracy required will vary from job to job, and may involve triangulation survey as well as use of latest techniques such as Disto mats, laser beams etc.

Equipment:

4.19 The type of equipment to be used for drilling & blasting of rock for excavation of tunnel has to be determined at the planning stage itself, and its selection depends on the desirable time cycle vis-a-vis economy, the extent of fragmentation desired, and the feasibility of making available and laying services such as electric power lines, ventilation ducting, compressed air lines, water supply & dewatering lines, telephone system, rail track etc. Where speed of work is the criterion and adequate foreign exchange is available, we have before us the choice of unlimited drilling and tunnel boring equipments suited for every contingency but for the present Indian conditions the established Drill-Blast-Muck operation is still the cheapest mode of tunnelling.

Safety Consideration and Ventilation:

4.20 The safety considerations in the tunnel, including supply of fresh air for ventilation, the quantum of which varies depending on the type of equipment and number of persons, are to be laid down.

Grade of Tunnel:

4.21 The grade of tunnel has to be kept keeping in view the economical operating range of the equipment planned to the extent practicable. If however, the grade of tunnel is required to be steeper to cater for technical or other requirements, the equipment planned has to be modified to suit the grade of the tunnel.

Dewatering of Tunnel:

4.22 The extent of seepage water anticipated, which will have to be-

drained off and/or pumped out depending on the grade of tunnel, and the provision for dewatering arrangements has to be specified specially in the Himalayan tunnels, as in course of time we will have to tackle jobs below the snow capped mountains. The type of pumping equipment will be dependent on the availability of adequate electric power for the execution of the project.

Instrumentation:

4.23 To record the rock loads actually developed and also for carrying out other geotechnical observations, instrumentation is to be provided, in consultation with Mining Research Institute, Dhanbad and other research organisations already engaged in this work. This will help not only the maintenance of tunnel later but the data collected will come in handy for other jobs yet to come up.

Lining of Tunnel:

4.24 The type of tunnel lining to be provided viz., steel or concrete or leaving the tunnel unlined except in stretches where rock is weak, is dependent on the condition of strata as anticipated, and the purpose for which the tunnel is to be used.

In case of steel lining, the type of steel to be used, and method of construction of lining is to be specified.

In case of concrete lining, the strength required, type of concrete to be used, the requirement for quality of ingredients, their mixing, haulage, placement and consolidation are to be specified.. The type of shuttering to be adopted viz., timber or steel, is to be specified, as also the accuracy in the finished section of lined tunnel.

Quality Control and Inspection:

4.25 The requirement of quality control for various operations of tunnel construction, and the Inspections to be carried out by inspecting agencies for approval at various stages, is to be laid down in advance to avoid delay during the stage of execution.

Risks:

4.26 Based on the detailed investigations carried out, the type of work anticipated and the extent of variation likely should be specified. The modus operandi to be followed in case of change in conditions encountered during execution should be defined.

Measurement and Payment:

4.27 The specification should define the method of measurement to be

adopted for various items of work. It is suggested that the quantity of excavation be measured in cubic metres and shall be the solid volume of the tunnel section measured within pay line specified by the Engineer-in-charge, irrespective of whether or not the actual excavation falls within or beyond the said line.

Definitions:

a) Minimum Excavation Line:

This is the line defining the boundary of the tunnel section within which no unexcavated material of any kind and no support other than permanent structural support shall be permitted to remain.

b) Pay Line:

This is the line set parallel to the minimum excavation line on its outer side and denotes the mean line upto which payment of excavation and concrete will be made, irrespective of whether the actual excavation line falls within or outside it.

The distance between "Minimum excavation line" and "Payline" depend on the type of rock met with and experience of operation in such rocks; however the following values are recommended as a general guide:-

i)	Good rock amenable to excavation to require shape	150 mm
ii)	Moderately Jointed rock	200 mm
iii)	Highly Jointed rock	250 mm
iv)	Bad Weathered rock	300 mm

Payment of Excavation:

Cross-section for computing quantity of excavation may be taken at interval of 1 m to 3 m along the alignment of tunnel. The payment for the excavation may be made over each such interval of length as follows:-

i) If the quantity of actual excavation is equal or less than the theoretical quantity computed on basis of payline, the payment shall be made at full rate applicable and for the theoretical quantity computed on basis of payline.

ii) If the quantity of actual excavation is more than the theoretical quantity computed on basis of payline, the quantity of actual excavation shall be split up in two parts and payment shall be made as:

a) For the theoretical quantity computed on the basis of payline at full applicable rate.

b) For the balance quantity at ¼ of the applicable rate.

The payment for (b) above shall, however, be considered admissible only if the following conditions are satisfied.

i) The over-breaks are caused due to concealed jointsfaults and other structural defects in the rock and not due to lack of reasonable care and skill in excavation on the part of contractor.

ii) The overbreaks extend beyond payline for the distance exceeding 500 mm.

iii) The quantity of overbreak in a single patch exceeds $3m^3$.

Items of Work of Repetitive Nature:

4.28 In the River Valley Projects, on many occasions as in case of small works like cross drainage works or other structures on canals, branches and distributaries have items of works of repetitive nature without much variations in the specifications. In such cases, there would be strong case for standardisation of specifications for such repetitive items so that errors in drafting are minimised. In Maharashtra and Tamil-Nadu where Contractual specifications for many items of work, which are frequently required in public works, have been drawn by special officers for use in the State and they are used by giving a mere reference to the items, paragraphs in the contract specifications, as required, even in such cases, for large works in the River Valley Project, it would be necessary to examine every time whether such general specifications were applicable to work in question. The Committee is of the opinion that synthesis of the standard specifications framed by several States and Departments be undertaken by a specialised cell as a whole time job.

4.29 Conclusion and Recommendations:

1) I.S.I. have so far published 200 standard specifically pertaining to various aspects and design construction etc., of River Valley Projects. Wherever Indian Standard Code of practices are available, which give detailed specification of workmanship, they should be incorporated in the contract specifications to the extent they are applicable to the item of work.

2) While drafting the contract specification only reference to relevant Indian Standards in respect of quality of input and method of testing the input and sampling be given instead of repeating the same.

3) For large number of items connected with River Valley Projects, a standard pattern of uniform Contract specification can be drawn up to remove the present inconsistency, which many a times occur while drafting job specifications for each job.

4) Great care and importance has to be given to formulating of specifications, taking into account the various conditions under which works have to be executed.

5) In the River Valley Projects on many occasions, as in case of small works, like cross drainage works or other structures on Canals, branches and distributaries, have items of work of repetitive nature without much variations in the specifications. Standardization of specification for such repetitive items is required.

6) Synthesis of the standard specifications framed by several States and Departments be undertaken by a specialised cell as a whole time job.

V. STANDARD METHODS OF MEASUREMENTS PARTICULARLY FOR ITEMS LIKE EARTH WORK IN EMBANKMENTS, BOULDERS STACKING AND REPLACEMENT, OVER BREAKAGE IN TUNNELLING ETC.

CHAPTER V

STANDARD METHODS OF MEASUREMENT

EXISTING PRACTICES:

5.01 Measurement occupies a very important place in planning and execution of any river valley project from the time of first estimate to final completion as well as settlement of payments to the construction agencies. Methods followed for measurements not being uniform, considerable difficulties exist between the practices followed by one construction agency and another and also between various Central and State Government departments. While it is recognised that the system of measurements being followed in an organisation is also based on the traditional procedures in the area, the Committee feels that the unification of various systems at technical level should be very desirable, particularly, as it permits a wider circle of operation for civil engineering contracts and elemination of ambiguity and misunderstanding arising out of inadequate understandings of various systems followed by different organisation, which so often lead to disputes thereby affecting the Cost Control of River Valley Projects adversely.

5.02 In Public Works Departments, including Irrigation Departments, at the Central and State level, engaged in civil engineering construction there is a standard practice of formulation of Schedule of Rates of various items applicable to the area of operation. Such schedule of rates invariably specify mode of measurements of various items. The Indian Standard Institute (ISI) have also brought out Indian Standards for method of measurements of buildings and civil engineering works, in 25 parts covering amongst others the items of Earth Work, Cement Concrete, Stone masonry, Form work, Tunnelling, well foundation etc. A seperate Committee ;for method of measurement of works for River Valley Project has been set up to formulate standards for measurements practices specially for works of Multipurpose River Valley Projects and the Committee has already identified about 10 subjects for formulation of standards. It is suggested that reference should be made in contract specifications and tender documents that method of measurement should be as per Indian Standards.

RECOMMENDATIONS:

5.03 Whereas these standards provide comprehensive guidance for measurements for Works in the field of building and civil engineering Works, industrial structure etc., the Committee feels that in order to make the contract unambiguous, it would be proper to provide method of measurements along with the specifications for each such items of Work involved in the Schedule of quantities for the contract for which a separate rate is stipulated in the contract.

5.04 After detailed deliberations the Committee is of the opinion that uniform methods of measurements should be prescribed for all such items for which uniform standard specifications have been proposed.

VI. ANALYSIS OF RATES BOTH FOR MANUAL AS WELL AS MACHINERY WORKS

CHAPTER VI

ANALYSIS OF RATES BOTH FOR MANUAL AS WELL AS MACHINERY ETC.

Necessity and Limitations:

6.01 Under the terms of reference II (d) of Committee on Cost Control of River Valley Projects, it is envisaged to prepare standard formats for analysis of rates of various standard items of universal nature pertaining to river valley projects both for manual and machine working. This is an attempt to evolve comprehensive standard schedule of Rates, at least, for the major items which largely constitute the major portion of the project estimate etc. Needless to say that due to the diversity of existing construction practices there is bound to be same variation between the prevailing practice and the previsions in the standard schedule of Rates.

6.02 After Independence, the impact of Socio-economic development brought in its wake a certain degree of mechanisation in the developmental activities in the country. The gigantic multi-purpose River Valley Projects, which have been constructed called for deployment of heavy construction equipment on a large scale. Before proceeding for analysis of rate for a unit item by Machine working, it is essential to workout the hourly use rate of Machine/Equipment intended to be deployed in completion of the particular item. For analysis of hourly use rate same 42 Nos. of machines and equipments have been identified which are at present being normally deployed for various types of river valley projects. These machines include the latest type of equipments which are in use now a days. The list of these machines/equipments is enclosed as Annex. VI. There are several methods of determining the probable cost of owing and operating construction equipment. Known method will give exact cost under all operation conditions. At best, the estimate can only be a close approximation of the cost. Carefully kept records for the equipment previously used could perhaps give some informations which can be as a guide for a particular equipment. For working out the hourly use rate of equipments we have drawn materials from the projects of Ganga and Yamuna Valley and the CWC Guide book on transfer of used equipments. The general criteria adopted for analysis of Hourly use Rate of Machine/Equipment is dealt subsequently.

General Criteria:

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

(a) Ownership cost:
    (i) Depreciation;

(b) Operational Cost

i) Repair charges

ii) Depreciation and repair of tyres and tubes

iii) Operators and maintenance crew charges

iv) P.O.L. and Energy Charges;

v) Miscellaneous supplies.

6.04 The various elements as mentioned above may be evaluated as below:

(A) OWNERSHIP COST:

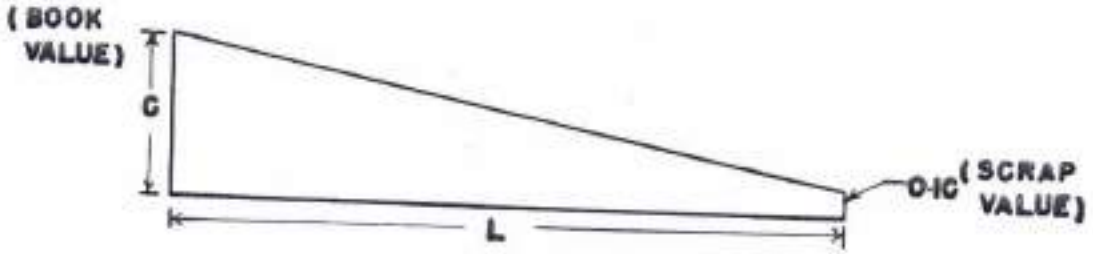
(i) Depreciation:

The depreciation of the Machine ranges from book value to scrap value. The scrap value of the machine shall be 10% of the book value. Depreciation in respect of New Machines/ equipments chargeable to the work shall be calculated as under :

Hourly depreciation = $\frac{0.9C}{L}$ as shown in fig. 1 below.

Depreciation of used equipment on transfer shall be calculated in proportion to the hours worked to life in hours as also in proportion to the period elapsed since its acquisition till the date of transfer to the life in years and whichever is greater shall be taken as the depreciation of the Machine as shown in fig. 2 below.

The depreciation of the used equipment may be computed by the modified straight line method starting from the acquisition cost till 50% of the cost in 40% of the life and till the residual value of 10% of cost in the remaining 60% of life as shown in fig. 2.



FIG·1 RESIDUAL VALUE DIAGRAM FOR NEW EQUIPMENT

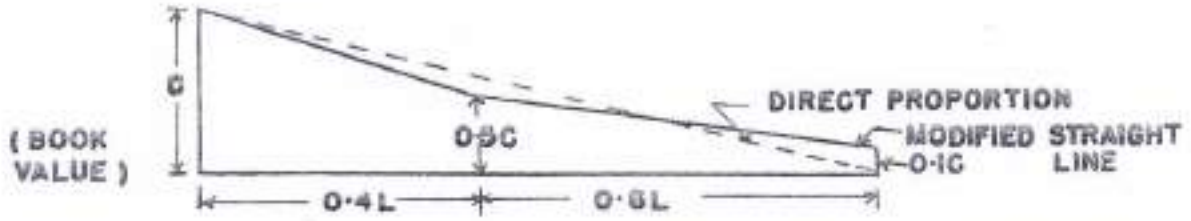


FIG.2 RESIDUAL VALUE DIAGRAM FOR USED EQUIPMENT- ON TRANSFER

Where 'C' is the book value of the new Machine which includes cost of the equipment, all taxes, Insurance and Carriage charges to the site plus the charges spent on erection and Commissioning of the Machine.

'L' is the life span of the machine in hours which are given in Annex.VII as recommended by C.P.M.C.-1972 and C.P.M. select group. In case of used equipment/machine the value of 'C' shall be taken as the current market price of the machine on the date of transfer. The depreciated value of the equipment shall then be worked out on the basis of the modified straight line diagram as shown in Fig.2 taking into consideration the market price of the machine.

Note: The depreciation of the equipment and tyres shall be claculated separately.

(B) OPERATIONAL COST:

(i) Repair Charges:

The repair charges should be taken as percentage of total cost of machine which will be varying from machine to machine. The percentage repair provision as mentioned in C.W.C. Guide book on transfer of used equipment have been adopted in the analysis of use rates of machines which are reproduced here in Annex. (VII).

(ii) Depreciation and Repair of Tyres and Tubes:

The hourly repair provision may be taken as 15% of the hourly

depreciation. Depreciation of tyres and tubes should be calculated on cost of tyres and tubes over the life of tyres and tubes in hours.

(iii) Operators and Maintenance Crew Charges:

Operators and maintenance crew required to handle a particular machine/equipment, as mentioned in Annex. VIII have been adopted in the analysis of hourly use rate. The labour constants for handling of the machines are based mostly on the provisions of similar type of machines being used in the various projects of the State of Uttar Pradesh. The crew charges have been worked out as per actual annual cost over the operational hours during the year. The crew charges have been worked out for various categories as per formula given below:

$$\text{Hourly cost of a particular category of worker} = \frac{\text{Monthly Salary} \times 12}{\text{Annual operational construction hours of the machine}}$$

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 can be worked out by knowing the total life of the machine in years and the scheduled operational hours.

As regards the quantum of hidden costs of the labour inspite of best effort it has not been possible to get actual details of expenditure on various elements of hidden cost and as such over and above the crew charges so worked out, a provision of 50% has also been made for hidden cost of labour to account for amenities to labour such as camp facilities, leave reserve, hill & hazard allowance and taking into account the non-working period in flood season.

(iv) P.O.L. Charge and Energy Charges:

Optimum fuel consumption per hour may be calculated from the following:-

$$\frac{0.5 \times BHP \times C \times 4.5}{8.26} \text{ litres per hour.}$$

Where 0.5 is the specified fuel consumption of HSD and BHP is the rated H.P. of the Engine, 8.26 is the Lbs., to an imperial gallon of HSD.

Equipment used in the construction industry seldom operate at a constant output or at rated output, except for a short periods of time.

A tractor engine may operate at maximum power when it is leading a scraper or negotiating an adverse slope. During the balance of its cycle the demand on the engine will be reduced substantially, resulting in decreased consumption of fuel. To allow for this the value of load factor (C) may be taken as follows as recommended by the construction plant and machinery Committee-1972, taking into consideration the job condition also.

		Excellent	Average	Severe
i)	Wheel type equipment (on road)	0.25	0.30	0.40
ii)	Wheel type equipment (Off road)	0.50	0.55	0.60
iii)	Truck type Tractors	0.50	0.63	0.75
iv)	Excavators	0.50	0.55	0.60

Construction equipment is seldom operated the 60 min. in an hour and therfore, the actual fuel consumption has been adopted as 2/3 of the optimum fuel consumption worked out from the above formula.

20 to 25% of the cost of fuel might be provided for the purpose of cost of lubricants depending upon the type of equipment. The electrical energy charges would be as per actuals.

(v) Miscellaneous Supplies:

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

6.05 Based on above, the formats for working out hourly use rate of various equipments deployed in River Valley Projects construction are given in the volume II.

GENERAL CRITERIA FOR ANALYSIS OF RATES:

6.06 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 computations of their cost. While the quantities depend upon the layout and the 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 labour and the share of machines involved in executing various items of the work.

6.07 As the Project cost estimates are made before the work is done, the estimate 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 necessary.

6.08 Analysis of rates include assessment of five essential aspects contributing towards the cost of an item of work:

a) Criteria: Estimating various operations involved.

b) Material Cost: Evaluation of material constants, requirement of quantities and costs.

c) Labour Cost: Estimating Labour constants and costs.

d) Plant Cost: Estimating the type & No., of equipment needs to workout hourly use rate of.

e) Contractor's Overhead & Profits: Cost of supervision charges and allocating and reasonable Contractor's profit.

Criteria:

6.09 To facilitate the analysis of rate for any particular item of work, the various operations contributing towards the item of work are to be analysed separately. A particular operation inturn involves the application of a group of workers, materials and equipment. 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.

Material Cost:

6.10 The quantitative assessment of material requirements may be taken as recommended in the report of the rates and cost committee of Janaury'56. The quantitative assessment in respect of certain item if not available in the report may be adopted from other authoritative books or through independent calculations based on data of the other projects.

6.11 The unit cost of various materials may be taken as those prevalent in the States. The appropriate cost for freight, unloading, cartage, storage, inspection and testing etc., should also be included. The rates of cement, steel, explosives, diesel, oil, petrol etc., should be based on the latest circulars, from the office of the Director General of Supplies and Disposal, State Trading Corporation and Indian Iron and Steel Controller respectively. The rates of other items may be adopted as being obtained on the projects of nearby area.

6.12 Over and above the theoretical quantities of materials computed by existing norms and practices there should be an adequate provision for wastage allowance and incidentals to the work in the analysis of rates on all accounts including handling, short weight, losses in storage etc. This allowance or wastage and incidentals to work may be taken upto 5% of quantities in case of cement, while for steel this provision may be made upto 2½% only as there will be some salvage value of the steel scrap. In the analysis of rates this provision has been made @ 5% for cement and 2½% for steel reinforcement, and gates etc.

Labour Cost:

6.13 The time which a labourer takes in performing a unit of work would vary personal factors such as climatic conditions, job supervision and complexities of operation. The assessment of output of labour should be made as per recommendations contained in the report of Rates and Cost Committee January 1956 (Part-I). The labour constants, required for certain items not covered by the above report; may be taken in consultation with those adopted in the various river valley projects of similar nature.

Wage Rates and Hidden Cost of Labour:

6.14 Daily wage rate structure as given in Table 15.2.1 of the report of rates and cost committee Jan., '56 need enhancement due to rise in price index. The wages of workers are periodically revised by the State under the statutory Labour Laws and daily wage rates therefore, should be taken as those prevalent in the States at the time of formulation of the projects.

6.15 Apart from the basic wage of a worker, there are other liabilities accrued 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 items.

i) Hill compensatory allowance
ii) Hazard allowance
iii) Travelling allowance
iv) Medical expenses or benefits.
v) Workman compensation.
vi) Free water supply and Power
vii) Subsidized ration
viii) Mess Services
ix) Other amenities likely free dresses, gum boots, helmets, woollens and mess utensils.

Besides above, in the River Valley Projects, work cannot continue throughout the year as it has to be stopped during the flood season. In some projects casual workers system is not accepted and continuity of the service is given to many workers depending upon the situation at the project and prevalent practices. The effect of this should also have to be considered in the wage rates. The judicious provision of this hidden cost of labour, therefore, has to be made over and above the basic wage rate of the labour for each individual project depending on the Statuary provisions applicable and practices prevalent for benefits and amenities of workers in the project. In the analysis of rates, this hidden cost of labour has been adopted as 50% of the direct labour cost.

Plant Cost:

6.16 The report of the"construction plant and machinery Committee" of 1972 has laid down guide lines for "hourly use rates" of equipments and have made recommendations for life of equipment and repair provision etc. These norms have been adopted for determination of the cost of operations of the plant. The hourly use rate of any equipment comprising of all the charges have already been dealt in the para 6.03.

6.17 Prices of various equipment at project site should be taken on the basis of recent quotations including all taxes and freight etc., where as the life of machines and the charges on account of depreciation repairs and maintenance should be taken as given in the para 6.03 General Criteria on hourly use rate of various machines and equipments. The proforma for use rate of 42 machines and equipments as listed in Annex. VII are given separately in Volume II.

Contractor's Overhead & Profits:

6.18 For any job analysis the following two aspects are to be considered:

a) Items charged to work.

b) Managerial charges.

The items, charges to works, are the preliminary and enabling works such as ramps, work sheds, water supply, electrification arrangements, Plant foundation and erection etc. Where as the managerial charges which constitute the Contractor's over-head should include (i) Emoluments of managerial and clerical staff (ii) General establishment watch and ward, sanitary and mess etc. (iii) Local conveyance (iv) Travelling expenses (v) Medical and sanitation (vi) Social welfare (vii) Office expenses and (viii) Share of head office expenses. The Interest of all types and Bank Guarantee charges are considered direct charges and rightly debitable to works.

In addition to the contractor over-heads, a reasonable percentage of profit be allowed to the contractor. Since it is difficult to identify over-heads and profits precisely, both those together may be provided at 20% of the prime cost in the analysis of rates.

In case of departmental works, it is expected that the additional departmental charges, which may not include profit, would also be about 20%.

Based on above, the format for analysis of rates of various items as indicated in para 3.09 are dealt in volume-II.

N.B:-Whenever standard or schedule of rates are revised or there is necessity to do so, the primary guiding principle should be escalation in labour and material cost and not the trend of rates quoted by the Contractors

6.19 Conclusion and Recommendations:

i) For fixing the hourly use rate of Machines and Equipments the evaluation of various elements of ownership and operation cost should be done as detailed out.

ii) Format for working out hourly use rate of various machines and equipments deployed in River Valley Projects construction as given in volume II be followed.

iii) Judicious provision of hidden cost of labour has to be made over above the basic wage of the labour depending on statutory provisions applicable and practices prevalent for benefits and amenities to workers in the project. In the format of analysis this hidden cost has been adopted as 50% of the direct cost of labour.

iv) It is difficult to identify overheads and profits precisely a provision at 20% of prime cost as made in the analysis of rates is recommended.

v) Format of Analysis of items of Universal Nature as indicated in para 3.09 and as dealt in Volume II is recommended.

vi) Where standard or schedule of rates are revised or where is necessity to do so, the primary guiding principle should be escalation in Labour and Material Cost and not the trend of rates quoted by contractors.

VII. TECHNIQUES ON MATERIAL MANAGEMENT AND INVENTORY CONTROL

CHAPTER VII

MATERIAL MANAGEMENT AND INVENTORY CONTROL

Goals and Objectives:

7.01 Materials management in any Project is primarily concerned with supply, storage and control of incoming materials with the objective of ensuring that maximum value is obtained from the expenditure incurred on the same. The materials management plays a vital role in the efficient utilisation of resources. In the irrigation sector it is still more important to have proper utilisation of scarce construction materials, equipment, spare parts etc. The interest of project authorities in better Inventory management is much more now than it was a few years back. The word inventory implies the stock of physical goods or commodities. A classical definition of inventory may be that it is an idle resource of any kind having an economic value. From this it follows that the inventory control is planning and devising procedure to maintain an optimal level of the idle resources. Inventory control thus is also very important for a project. The annual inventory value of spares and equipment of any project may run in several crore of rupees. Much of it may be slow moving or non-moving dead stock. The adoption of modern systems and techniques of material management and inventory control is, therefore, necessary for the project to achieve optimum inventory levels and thus reducing the expense in maintaining the surplus stock while at the same time minimising the risk and frequency of costly stock-outs. This would lead to greater operational efficiency, optimum utilisation of materials and savings in costs.

Classification of Materials:

7.02 The materials can be classified in terms of different uses. This enables to appreciate the peculiarity and problems in the variety of uses. Another reason for a detailed differentiation based on the usage is to enable to adopt appropriate control techniques to suit the needs. Materials may be classified as raw materials, consumables, spares etc.

i) Raw Materials:

Raw materials are the major input into a project. As any break in the supply of these materials will keep the production idle, their importance can be easily visualized. There are two important factors which determine the requirement of this type of material. One is the consumption rate and other is the criticality or importance of the item. The tighter control has therefore to be exercised in the case of materials which have a higher consumption and higher criticality. The supply of raw materials may be regular or seasonal and its resources may be local or foreign.

These conditions will affect the lead time also. Depending upon the various conditions the requirement levels will have to be fixed.

ii) Consumables:

These are the materials which act as a catalyst in the production process, like fuel oil, lubricants etc. These can also be classified according to their consumption and criticality. In some cases a consumable like fuel oil accounts for gord quantity. Normally these items do not create any supply problem but there can be instances of shortages like one often finds in fuel oil.

iii) Spares:

Spare parts form an important class of inventory by themselves. Management of spares is a vexing problem and sufficient attention is necessary to resolve the various problems relating to them. It is estimated that spares worth rupees 50 crore are available in the country at present. Further about Rs.82 crore worth of spares may be required to be procured and handled during the VIth Plan period.

Materials Procurement:

7.03 The purchases during the construction stage of a river valley project relate not only to the materials which are issued direct to works but a host of other materials, tools and plant and equipment which are required for the workshop, transport yard, township, offices etc. The earth-moving machinery, ubiquitous in river-valley projects, finds its cost and expenditure on its operation and maintenance ultimately charged to works. Practically all the items of cost of a departmentally executed work except salaries, wages and cost of land relate directly or indirectly to purchase and transportation. From this can be imagined the importance of materials procurement and its constribution to cost control. Needless to add, the work 'Materials' has to be construed in a wider sense so as to include all the items of purchase.

The Nature of Items Purchased:

7.04 The list of annual purchases of a departmentally executed project will include cement, steel, quarried material, timber, ropes, industrial gases (or, items like calcium carbide, cylinders etc. for departmental manufacture and storage of industrial gases), welding materials, explosives and detonators, diesel, petrol and lubricants, paints, hardwares, clothing etc. for uniform of labour and security staff, fire-fighting equipment, office equipment and stationery, light and heavy vehicles and

tools and Plants, special tools and plants like earthmoving machinery, and the spare parts for the various tools and plants. The list is far from exhaustive and gives only a broad idea of the purchased items.

An Anatomy of The Present System:

7.05 The present system of materials procurement consists of the following stages:-

i) Indenting of materials required for use in the Divisions responsible for execution of the works as well as offices and Divisions which render services to the former.

ii) Consolidation of indents received in the Purchase Office from indentors.

iii) Preparation of tender documents and invitation of tenders.

iv) Receipt of tenders and tender-opening.

v) Preparation of comparative statement of tenders, scrutiny of tenders and correspondence/discussion with tenderers and drafting of purchase proposal. The proposal includes a discussion on comparative merits and demerits of the tenders and recommendation on acceptance of one (occasionally more than one) of the tenders.

vi) Decision on the purchase proposal and acceptance of the tender by an officer or a committee of Officers.

vii) Preparation of purchase order (or letter of acceptance of tender) embodying the terms and conditions of purchase and its despatch to the tenderer.

viii) Watch over the purchase order, chasing the progress, amendment to delivery clause and other clauses, where necessary, arrangement for pre-delivery inspection, where necessary.

ix) Receipt of materials, clearance from rail/road transport, preliminary survey of any damage and shortage, handling and further transportation to stores depot, inspection, taking the receipts in stock, despatch of inspection, reports and receipt sheets to all concerned.

x) Payment to the supplier. In many cases, 90% to 98% payment is made on receipt of documents, through supplier's banker, in support of goods despatched. The balance payment is made on completion of other requirements.

Review of The Present System:

7.06 (A) Any review of the present system of materials procurement and its inadequacies should be preceded by an acknowledgement of the fact that in a developing economy a forecast about availability of physical resources sometimes shows wide variations from real trends and there is a competition among different sectors of economy for the vital but scarce inputs. A purchaser, in a situation like this, is confronted with the baffling task of managing his requirements with what a scarcity-hit, inflationary market can offer. While analysing the limitations of the procurement system, the constraints created by competing demands for limited resources in a developing economy have to be given due allowance.

(B) The limitations of the existing system arise from the following:-

i) Absence of a Codification System of Stores:

A total absence of a codification system or its adoption in incomplete form results in delay in ordering and wrong ordering, especially for items under a common, broad category but with varying specifications.

ii) Technical Scrutiny of Tenders:

This scrutiny alongwith correspondence with tenderers in order to seek technical (and also commercial) clarifications from them turns out to be a time-consuming process. There are instances where validity of the tenders expired and tenderers asked for higher price while the technical scrutiny and examination of comparative merits of offers and subsequent clarifications received from the tenderers was still in progress.

iii) Standard Terms & Conditions:

The standard terms and conditions of the purchaser generally differ from those of the supplier and a reconciliation to the satisfaction of both the parties contributes to delay in selection of the tenders.

iv) Inadequate Delegation of Financial Powers:

The inadequacy relates to not only the official levels which have been delegated with powers but also to the nature or items of delegated powers e.g. financial limit for invitation of limited tenders.

v) Inflexibility of Outlook:

A rigid, uncompromising posture towards practical application of codified rules, regulations and orders generally stems from either a basic

conviction of principle or from a fear to offend the rules and invite attention of Audit and Vigilance. In either case, the procurement of materials is likely to suffer. However, there may be occasional instances where circumstances of a case might justify, in public interest, a strict observance of rules.

vi) Correspondence and File Movement:

In the existing system, a considerable time is taken by correspondences and movements of files on purchase cases within the Project, from one office/department to another, and between the project and the Government Secretariat when participation of the Secretariat in the process of tender-selection is required under the rules. In the offices and departments in the project and in the Secretariat the file moves through several levels. Even where the final selection of tenders is entrusted to a committee of several officers, the selection by the committee generally follows inter-departmental movements of the case files. Sometimes, an attempt to impart a widely representative character to a tender selection committee makes it such an unwieldy body that it is not easy to collect together all or the majority of the members some of whom, especially those in the Secretariat, have diverse businesses of the Government demanding their time and attention.

vii) Inadequate Follow-up Action:

There is often a considerable time-lag between the tender selection and the issue of the purchase order or acceptance of the tender. Except in complicated cases needing more than ordinary caution in draftsmanship, this time-lag can be attributed to under-staffing and/or general lethargy and limited efficiency of those who handle drafting of the purchase orders. Most of the suppliers stipulate a condition these days that the delivery period will be reckoned from receipt of complete technical and commercial clarification of the purchase order. That means more time, even after the purchase order has been placed. Further follow-up action of the orders with the suppliers, a timely co-ordination of inspection, readiness for despatch and arrangement for transportation, and a timely action to terminate defaulting contracts and tap alternative sources of supply are often conspicuously absent in many a purchase organisation. The prevailing tendency, in many cases, is to leave the actual delivery schedule to the choice of the supplier and then extend the contractual delivery period when the order has been executed.

viii) Human Error:

Instances do arise, once in a while, where in spite of the expertise employed the procurement turns out to be injudicious. A treatise on Materials Management cites a case where a buyer in U.S.A. placed a purchase order for locks and keys conforming to the same standard speci-

fication. The consignment arrived, and all the keys were found to be interchangeable.

A river-valley project in India imported some spare parts for an equipment which had been imported earlier, The spare parts, on arrival, were counted and taken in stock. Subsequently, when issued from stock, the parts were found to be unusable. The fact was that after the project had purchased the equipment, the supplier had introduced a new design for it, and the spare parts conforming to the latest design of the equipment could not fit into the old one.

ix) Circumstances Beyond the Control of Project:

These come under three broad categories:

(a) Pressure from an individual or a group which originates outside the project and is brought to bear on purchase decisions.

(b) In bilateral trade agreements between a developing economy and a developed one, the purchase requirements of the former are sometimes decided by the latter and the decision is not always wholly conducive to the buyer's interest. In a certain case machines purchased under a bilateral trade agreement and passed on to certain projects were found to be of extremely limited utility, at least in one major project.

(c) A default or delay in supply due to force majure conditions is beyond the control of the supplier. In such cases the contract generally leaves it open to the purchaser to make procurement from other sources but complication arises from the contractual obligation of taking over the finished and semi-finished products from the supplier. Besides, prevalence of force majure conditions like shortage of raw materials and energy in a developing economy renders difficult the selection of a dependable, alternative source of supply.

An unforeseen and sometimes unprecedented rise in the cost of inputs in an inflationary economy leads to a withdrawal of their firm commitments by the suppliers and a complete upsetting of the planned procurement programme of a project.

Effect of The Limitations:

7.07 The limitations in the working of the present system of procurement have a three-fold effect:

i) The delay in finalisation of the purchase results in delay in supply.

ii) The delay gives a chance to the prospective suppliers to back out when the period of validity of the tender is over.

iii) When quotations are not firm and are subject to price variation the delay generally leads to an enhanced price of the items of purchase.

Improvements in the Existing System:

7.08 After a broad survey of the existing system of procurement an attempt can be made now to suggest improvements in the working of the system. Within limitation of space, the suggestions can cover only some broad and important areas and not the inumerable details in each component of the system.

(a) Central Purchase Organisation:

Purchase should be entrusted to a Central Purchase Organisation in a project costing over Rs.50 crores, essentially to be executed departmentally. Such an organisation may also cater to the requirements of several projects located in adjacent areas. Simultaneously, the Division which execute works or render services should be delegated with powers of purchase upto a limited amount. The constitution of some of the Purchase upto a limited amount. The constitution of some of the Purchase Committees and powers delegated are indicated in annex.IX.

The officer who is selected to head the Central Purchase Organisation should possess an abundance of common sense, an ability to lead a team, a capacity for co-ordination with other departments, and professional knowledge and integrity. If he has a single-track mind, he will look to only one side of an issue and land in a blunder; if he looks into all the conceivable aspects of a problem with an equal emphasis on each, he will land nowhere. What he needs is a capacity to look around and ahead, an analytical mind to sift the consequentials from the inconsequentials and a sense of judgement to take or suggest what he considers to be the best of several alternative decisions. He should not too frequently look for guidance from the higher-ups, and they, in turn, should not too frequently interfere with his judgement.

(b) Systems Audit:

The functioning of the Purchase Organisation should be subjected to Systems Audit by a Cell established for this purpose and working directly under the Chief Executive Officer of the Project. The Cell should not be employed for voucher audit, review of all purchase orders, big and small, and for raising objections. The object of the Cell should be to review the various links in the chain of the entire system of purchase, assess functional efficiency of each component part of the system, bring

out the points of weakness and inadequacy and suggest concrete, practical measures for improvement. Some of the functional areas where Systems Audit can be effective are the working of the indenting System, over-indenting and under-indenting, invitation of tenders with special reference to whether letters inviting limited tenders are actually reaching the firms and whether there is an adequate response, progress chasing of the purchase orders, justification for continued purchase of proprietory articles on single tender basis, acceptance of the lowest tenders in relation to delivery of quality goods and long-term economy. The examples are by way of illustration only. In order to justify its existence, the Systems Audit Cell will need men with considerable degree of ingenuity imagination and a sound practical knowledge of the functional areas they will audit. By the way, the Cell can be usefully employed for review of other departments of a project.

(c) Commercial Intelligence:

There should be a small Commercial Intelligence Cell in every State to feed the purchase organisations of the various projects with commercial information. The Cell should collect information of interest to the purchaser from economic and commercial periodicals, trade journals and newspapers. Forecasts of market trends of rates and scarcity in supply will be the most important function of this Cell. The Cell should also act as a storage of information on indices of cost of labour and cost of materials like steel etc. which are useful for scrutiny of price variation claims of suppliers. Another important task of this Cell should be to collect information at the intervals from projects within the same State and similar Cells in other States about sources of procurement and prices paid for materials purchased by the projects so that the information can be interchanged and made use of.

(d) Tender Committee:

All the purchases, routine or emergent, to be made by the Central Purchase Organisation should be entrusted to Tender Committees or Purchase Committees. There should be different committees for purchases upto a lakh of rupees, more than a lakh and upto rupees ten lakhs and beyond rupees ten lakhs. The limits are by way of suggestions only. Each tender committee shall be fairly representative in composition but not unwieldly. A reasonable composition should include one or two representatives from the indenting departments, one from Purchase Organisation, one from Project Finance, and, in case of purchases beyond rupees five/ten lakhs, the Chief Executive of the project or his representative and one representative of the Government which finance the project. Where a Central Purchase Organisation caters for a number of projects, the composition will have to be suitably fixed.

For successful functioning of the tender committees, it is essential that the members should function as a team and not in isolated compartments where each can seek guidance or opinions from his departmental

staff. The representative of the Purchase Organisation in the Committee will get the comparative statements of tenders prepared and checked, draft a memorandum setting out the merits and demerits of different tenders and his recommendation on acceptance of tender, forward a copy of the purchase proposal and the comparative statement of tenders to each member of the committee and convene a meeting. Members can consult the tenders during the meeting or, in the purchase office, prior to the meetings. The practice of despatching files on tenders and purchase proposal to other departments within the project or to the Government Secretariat should be discountinued so as to terminate the system of extensive and often repetitive notings by all concerned and also not-so-concerned. Each member will be expected to see, think and contribute to the collective functioning of the committee rather than quote from his departmental notes. Technical and commercial clarifications from tenderers will be obtained by the Purchase Organisation before the purchase proposal is drafted, but it will be open to the committee to nrgotiate with the tenderers or suggest obtaining fresh clarification from them. A project should issue guide-lines for resolution of the differences of opinions that may occasionally arise in the committees.

While the purchase decisions will be made by the committees, they may, at their descretion, leave to the representatives of Purchase, Finance and Indentors subsequent decisions on amendment to delivery clause with or without levey of liquidated damages, amendment in payment terms, mode of transport, place of delivery and technical specifications (with or without the change in rates), and other technical and commercial clauses. Detailed guidelines in this regard can be laid down by the projects.

(e) Registration of Suppliers:

A notification in the Press should be issued and suppliers invited to get them registered with the Purchase Organisation. The final list should be a comprehensive one, containing the names of not only those who have registered after establishing their credentials but also other names collected from commercial section of telephone directories in metropolitan cities and other cities and towns located around the project sites. Voluntary offers from new firms for registration should be considered, and names of firms who default repeatedly or intentionally should be deleted.

(f) Delegation of Powers:

Once a comprehensive list of suppliers for different items is available, it should be possible to enhance the financial ceiling of limited tender purchase. The suggested ceiling is rupees two lakhs provided tenders are invited from at least six firms or all the firms listed for the item, whichever number is higher.

Delegation for other items to tender committees and officers should be adequate.

(g) Indenting:

Indents for purchase of various materials for consumption and for plant and machinery and tools and equipments to be used for works should be prepared by the various departments on an annual basis. The indents for the next financial year should be prepared during July/ August of the current financial year when the financial budget for the next year is prepared and the works programme is known. The indents should indicate the total requirements under each category and should reach the Purchase Organisation by first week of September.

The indents should be reviewed quarterly and supplementary indents indicating increase or reduction in demand should reach the Purchase Organisation by the first week of next quarter.

(h) Purchase and Progress-Chasing:

On receipt of indents from various departments/divisions the Purchase Organisation should consolidate the indents. The volume of purchase should cover not only the actual requirements for the next financial year but also requirements for the minimum stock level. Forecasting the minimum stock level and reduction of the total indented quantity where it is justified by existing stock position as well as anticipated accretion in stock from future supplies against previous indents and previous purchase orders (less anticipated issues during the next few months) will be an important task of the Purchase Organisation. This will require a considerable degree of prompt-co-ordination. It is essential that some senior Purchase Officers should personally make forecasts about the desirable volume of purchase for the next financial year in consultation with the Store-Keeping Organisation, the staff in the Purchase Organisation and the indentors. It is important to note that while and "A", "B", "C" analysis of the various items will be useful, the items under "A", "B" and "C" categories (fast moving, at a medium pace and slow moving) may keep on changing their category depending upon the stage of the project. For example, while materials required for residential and non-residential buildings will be "fast-moving items" when the township is under construction, they will cease to be so during the later stages of the project. Again, spare parts for earth-moving equipments will come under "A" category only when the equipments are employed extensively. Hence, a considerable degree of ingenuity and imagination will be called for when forecast is made for the desirable volume of annual purchase.

After the volume of purchase has been decided, purchase actions will be initiated. It will be necessary to divide the proposed purchases

into three categories on the basis of anticipated delivery schedules which will be long for certain items, medium for certain others and comparatively short for the rest. The categorisation should also take into consideration the current stock, the anticipated pace of issue and the volume of the purchases to be made under each case. The priority to be given to different categories for invitation of tenders and processing of purchase cases will be decided accordingly. It is expected that all the purchase cases should be finalised in course of the next six months of the current financial year (i.e. October to March)

On receipt of revised quarterly indents from the indentors, the Purchase Organisation should review the volume of purchases decided earlier. An attempt should be made to curtail or increase the volume of supplies, wherever necessary.

Needless to add, it will be futile to expect that purchas programme will proceed with clock-wise precision as a result of improvements in procedure. Purchases with a very long delivery schedule extending beyond a year, default by suppliers, sudden emergency requirements and numerous other problems will be encountered even in the best system. No hard and fast rules can be laid down for their solution.

After the purchases have been finalised and orders placed on the suppliers, review of the supply position and progress-chasing will be the foremost task. The progress review can be conveniently done with the help of an extract from the purchase order containing the name and address of of supplier, number and date of the purchase order, the name of the item/items of purchase, the quantity, the rates, the inspection clause, the delivery schedule and the point of delivery (Ex-works, Ex-station of supply and at destination). Any amendment to these clauses in the purchase order should be simultaneously reflected in the extract. The master file containing the purchase order summaries can be subjected to an easy review and further action for progress-chasing can be taken. When the purchases have been received and taken on stock, the quantity actually taken on stock should be indicated in the purchase order summary. The documents should be treated as closed when the supplies have been completed and the supplier has been paid fully, or if the order has been cancelled.

To ensure quality supply in time, it is better to make purchases from manufacturers and dealers with All-India reputation. Where purchases are made from dealers and middle-man, the prospective suppliers should be asked to indicate the name and address of the manufacturer and a list of some purchasers whose orders for the same item they have previously executed, the quantity supplied and the year of supply.

(i) Change in Approach and Outlook:

While rules and procedures are meant for enforcement in public interest, it is necessary to remember that good business relations with

suppliers are no less an integral part of the same public interest. Changes and relaxations in Rules and Procedures take time, but problems are of every day occurrence, and it is impossible to achieve dynamism, essential to a developing economy, within a set of static rules and procedures unless a practical view of their basic intention is taken. There is scarcely any contribution to public interest and economy if business relations with suppliers are embittered by a routine enforcement of the purchaser's contractual right to impose penality or liquidated damages even where there has been no prolonged delay in supply (force majure conditions apart), or by creating a deadlock when supplies, on delivery, are found to be somewhat below the strict specifications but nevertheless usable and it is possible to accept them with or without some repair at purchaser's expense and at reasonably lower price which can be negotiated with the supplier. These and many other points call for a change in outlook not only in the projects but also on the part of their Audit and Vigilance Authorities.

A.B.C. Analysis of Spare Parts

7.09 A.B.C. Analysis is an act of separating the significant few from the relatively un-important many. In the context of inventory control, the analysis categories items into three categories as below:

'A' Category of High Value Items

These are in small numbers representing bulk of the expenditure incurred during the year. Usually these items which are about 10% of the total spare parts, represent 75% of the money spent for material. The items are to be so ordered, as to keep the investment in Inventory as low as possible.

'B' Category of Medium Value Items

These are of secondary importance because they do not require as detailed and cost control as 'A' items, but they need more attention and control than 'C' Items. These are the intermediate items which represent about 10 to 20% of the total quantity of items and may make up 15 to 20% of the total expenditures for the materials.

'C' Category of Low Value Items

These are numerous inexpensive items which make up about 5 to 10% of the total expenditure for material and represent as much as about 70% of the total number of items used. The production may be held up for want of any one of these items. The 'C' Items should therefore, be purchased in large quantities in order to

secure purchase discounts, and minimise time and effort required on the part of stores personnel. A sufficient stock of these items should be maintained on the projects since the investment is small and this decreases the possibility of the machines waiting for these parts.

7.10 The quantity of reserve stock should vary with the consumption value of the item. In the case of 'C' items large reserve stocks should be maintained to avoid the possibility of running short of them. In the case of 'A' items only the barest minimum reserve stock should be maintained. 'A' items are also procured in smaller quantities to keep the investment as low as possible.

7.11 However, in some cases cost analysis alone cannot decide whether a part should be stocked or not. As for instance, insurance items which may or may not be used during the entire life time of the equipment and slow moving items even though they may be costly, have to be necessarily stored, in view of the excessive lead time involved due to the procedural delays in the procurement of these parts from indigenous sources or otherwise.

7.12 The classification of items may, therefore, has to be made depending on whether an item is vital, essential or desirable so as to reflect the above intangibles.

Fixation of Norms:

7.13 The inventory of spare parts and other stock items should be maintained at a suitable level that meets normal maintenance requirements at the lowest total cost. To achieve these goals following four critical inventory control points must be established for each item in storage;

1. Minimum inventory level
2. Order Point
3. Economic Order Quantity
4. Maximum Inventory Level

7.14 For solving this vexed problem, two pronged attacks at the micro and macro level should be adopted. It is necessary to implement rational control systems at the project level and then tackle the issues at the State level. At the project level, codification, classification and computerised processing for spare parts and other stock items are the foundations on which the control system should be built up. Codification facilitates a proper identification of inventory establishing the extent of their commonality, as well as carrying out standardisation measures. Classification facilitates the adoption of proper replenishment policies for different classes of items, Computerisation facilitates the establishment of a data bank of spare parts at the utility level, the applica-

tion of dynamic mathematical models for fixing levels for stock items and for review of slow moving/non-moving parts.

7.15 Fixation of norms should normally be done by Materials Department in close consultation with the engineers concerned. Apart from the exercise mentioned above, adoption of following analytical approaches may be of immense help to determine the inventory levels.

(a) Operation Research:

This is basically a tool for programmed decision making and control. Its object is to establish quantitative relationship as an aid for integrated effort towards equitable co-ordination of men, materials and machines ensuring effective operation to achieve objectives of the project.

(b) Linear Programming:

It is an analytical method for minimizing and maximising any objective or functional value if linear under constraints, which are linearly related to variable in the objective function. This technique can be a versatile aid to inventory planning and can be applied for (1) Scheduling of Supplies. (2) Maximising transportation and storage cost (3) Value analysis and (4) providing justification for an additional equipment and spare parts etc.

Analytical representation of this technique is generally done in two ways

1. System of matrices.
2. System of vectors.

(c) Dynamic Programming

Application of this technique may become necessary when the relationship among various factors is not linear due to various reasons. Critical path Analysis is a special but limited case of dynamic programming . However, this analysis can be useful in determining levels of inventory.

With the aid of these techniques, if applied scientifically both for forecasting and fixation of norms, we can easily determine inventory which should be held in totality at any particular given time for a particular project. Based on the information available, the following norms are suggested for the spares.

		Imported	Indigenous
1.	East moving consumable spares	8%	5%
2.	Slow moving spares	2%	2%
3.	Insurance spares	5%	3%

The above percentages relate to the cost of the equipment and at no time the inventory of spares in terms of value should be higher than the percentages mentioned above, in relation to the cost of equipment.

However, one cannot afford to be very rigid and in certain cases it may become necessary to provide for more spares in any one of the three categories mentioned above in respect of particular plant/equipment. It is, therefore necessary that overall guidelines for the inventory of spares should also be provided. The norms given below are in terms of value based on past consumption and in terms of percentage in case of insurance spared and will differ from project to project depending on factors such as location, working conditions, period of construction, and, therefore, minimum and maximum levels have been suggested.

	Imported		Indigenous	
	Minimum	Maximum	Minimum	Maximum
1. Consumable spares including slow moving spares	15 Months	30 Months	4 Months	6 Months
2. Insurance spares	3%	5%	1.5%	3%

Segregating Insurance Spares

7.16 Spare parts which do not wear and tear during normal working life of the equipment but are required to be stocked to safeguard against high down time cost in case of their break-down are categorised as Insurance spares.

7.17 Whether to buy an expensive Assembly or the complete component as insurance spare is indeed a difficult question to answer. The probability of its being required is usually very low, yet if it is not readily available when required the loss in production is so heavy as to be forbidding. A method to arrive at a decision rule in such cases is as under:-

Let 'p' be the probability of the spare being required 'Cu' the cost of the item Cs the loss due to its not being in stock or its shortage cost.

Then, it would be advisable to keep the item in stock if

$$p \cdot Cs \geq Cu$$

It is extremely difficult to obtain the value of p, though it is low, But the threshold at which the decision to keep the item in stock

or not tilts one way or the other, is when the above expression becomes an equality, i.e.

$$\text{When } p.\ Cs = Cu$$
$$\text{or } \quad p = \frac{Cu}{Cs}$$

'Cu' is known and it is easier to guess or get an estimate of the value of 'Cs' than the value initially of 'p'. It has, however, to be noted that 'Cs' which is, under the circumstances, very high in value in comparison to 'Cu' features in the denominator and even a larger error in its estimate will not greatly effect the value of 'p' or greatly alter the ultimate decision to be taken.

Once the value of 'p' has been so evaluated, the authorities could be asked specifically if they agree with it. There is a greater chance of obtaining a meaningful response to such a question than to the earlier one regarding an estimate of 'p'. Large scale disagreements can be accommodated by suitably modifying the value of 'p'. Finally the decision rule:-

By the item if p. Cs $\overline{\quad //}$ Cu.

Elaborate variations of this approach are available in the literature for deciding on multiple spares for several of the same equipment in use.

Automatic Replenishment Systems:

7.18 The Principal objectives of inventory control are to reduce investment in inventories and simultaneously to minimise idle time by avoiding stock-outs and shortages. The science of inventory management has developed to highly sophisticated level in advanced countries and many possible ramifications of demand situations e.g. uncertainty, certainty, reasonability etc. have been intensively explored. Economic lot size analysis for purchase and consumption, combined with probability analysis for determining safety stock or re-order point levels are the most widely used techniques.

7.19 For consideration of the Replenishment system appropriate answers are required to be found out for the following two questions:-

1) When to order more stock.
2) How much to order.

Basically, there are two types of Inventory Control Systems, although both have numerous variations one is termed the "Fixed Order-size system" and the other "Fixed-order-intervals system".

Fixed-Order-Size-System:

7.20 This is also known as two-Bin-System. In this system the order quantity is fixed and the frequency of ordering varies and is determined by the fluctuations in demand. This system is completely specified for any item by the quantities:

a) Order Quantity (Q)
b) Re-Order Level (r)

Inventory position at any instant of time is defined as stock on hand plus on order minus shortages, if any, The operating, procedure then consists of placing an order for a quantity 'Q' when the Inventory position reaches 'r'. The re-order level 'r' is based on the formula.

r = Average consumption during lead time + Safety Stock.

The major stock disadvantage of this system is that it requires perpetual auditing of the Inventory on hand.

Fixed-Order-Interval System:

7.21 This is also known as periodic Review system or the Cycle System. This system has a fixed ordering interval and the size of the order may vary with the fluctuations in demand. This system is specified for any item by (i) Review period (T) and (ii) Requisition in objective (R). The operating procedure consists of reviewing the inventory position regularly once in every T units of time. If at any particular review the inventory position is say Z, then order for R-Z units. The calculations of R is based on the formula.

R = Average consumption during a review period + lead time + safety stock.

7.22 The fixed-order-size system is more suitable for 'C' and low value 'B' items. The fixed-order-interval system with its frequent and careful review is suitable for 'A' and high value 'B' items. For given risk of stock-out, the fixed order-interval system requires more of safety stock as compared with the fixed-order-size system.

The problems of stock control begins logically with the order for raw material or spares or general stores. This deals with the most economic pattern of ordering the materials. In the fixed-order-system, which is most commonly used the problem is to find the order quantity (Q) which will minimise the total cost over a long period. This is called the economic order quantity (EOQ).

In the fixed-order-interval system the problem is to find the economic-review-period (ERP).

Cost Function:

7.23 The first step is to obtain an expression for the total annual cost of purchasing and holding stock and of placing orders ignoring any costs which are independent of the order quantity and therefore do not effect EOQ.

Let
A = Cost of ordering in Rupees per order.
I = Cost of varying the inventory as annual rate of interest on the money value of inventory expressed as fraction.
D = Annual Demand (units).
C = Cost price per unit.
Y = C D = value of yearly demand.
Q = Order quantity in units.
T = Review period.
QRS = Order quantity in rupees value.

In the calculations for the economic review period A includes not only the cost of ordering, but also the cost of a review.

7.24 Every time an order is placed in Fixed-Order-Size system, a quantity Q is ordered. Thus there will D/Q orders per year and hence the yearly cost of ordering will be $\frac{AD}{Q}$. Since the order quantity is Q, the average inventory will be ½ Q and its money value will be ½ CQ. The carrying cost per year will then be ½ CQ. Thus, the total variable cost (TVC) will be $Z = TVC = \frac{DA}{Q} + \frac{1}{2} CQ$.

TVC will be minimum if $\frac{DA}{Q} = \frac{ICQ}{2}$

Fixed-order-size system square Root Formula for EQQ

$$Q = \sqrt{2.\frac{AD}{IC}} = K \sqrt{\frac{D}{C}} \quad \text{Where} \quad K = \sqrt{\frac{2A}{I}} \quad \text{EQQ Constant}$$

Minimum total variable cost = $\sqrt{2A \quad I \; D \; C}$

The EOQ can be expressed in different ways and some of them are as under:-

$$Q = K\sqrt{\frac{D}{C}} \quad (\text{EOQ in units})$$

$$n = \sqrt{\frac{Y}{K}} \quad \text{(number of orders per year)}$$

$$Y = CD$$

Fixed-Order-Interval System Economic Review Period:

7.25 The EOQ formula can be used to calculate the economic review period T for the fixed-interval system. In this case 'A' denotes the sum of cost per order and cost per review.

The economic review period T will be:

$$T \text{ (in years)} = \frac{Q}{D} = \frac{1}{D} = \sqrt{\frac{2AD}{IC}} = \sqrt{\frac{2A}{ICD}} = \frac{K}{\sqrt{Y}}$$

$$T \text{ (in months)} = 12 \frac{K}{\sqrt{Y}}$$

If review cost is negligible, A can be taken as cost per order.

Safety Stock and Re-Order Level:

7.26 Safety stock (S) or Buffer stock is the additional stock needed to allow for delay in delivery or for any above-average demand that may arise during lead time, i.e., the time between deciding to place an order and receiving replenishments. Under the fixed order size system, the re-order level (r) is given by the sum of the average demand during a lead time and safety stock.

$$r = m + S$$

If the lead time and the demand were certain, there would be no need for buffer stock, but this rarely occurs.

7.27 Statistical methods are available for calculating re-order level (r) or safety stock (s). The frequently used approach is to determine the Safety stock to obtain a desired level of performance on the basis of "Shortage".

7.28 A shortage is the absence of material to satisfy the dema when it occurs. This statement defines a shortage but does not say it will be measured; except to imply that its value is zero if ther no demand awaiting satisfaction. There are in fact many ways of mea ing shortage, one of which should be appropriate in a particular in

tory management situation. The ways of measuring shortages are as follows:-

Occurrence of Shortage:

This is the probability of stock out or the occurrence of an out of stock situation. In this method of measurement, a single shortage occurs as soon as demand for an item exceeds stock on hand and persists until additional material is received. A major advantage of this method is the simplicity in recording shortages and in computing reorder levels to meet specified level of service. However, its disadvantage is that it does not differentiate between the number of units short (say 10 to 1000) or those that persists for 1 day, 1 week or 1 month.

Number of Units Short:

A second measure of shortage is the total number of units short at the time additional material is received. This method requires counting of number of units in the back order file at the time additional material is received.

Time out of Stock:

Another measure of shortage describes not the extent of shortages in units but the length of the time an out of stock situation occurs. For this it is necessary to record, the date on which the item first went out of stock and the date on which additional stock was received, the difference in dates is the time out of stock.

Time Weighted Units Short:

This measure of shortage is a combination of the magnitude of shortages and their duration or persistence, In certain situations, the consequences of a shortage may depend not only on the number of units short but also on the length of time for which the shortage was experienced. For this not only the back orders must be recorded, but the dates of establishment and satisfaction must also be noted. Clearly, this would require considerable record keeping and arithmetic. However, there are circumstances in which this expression of shortages appropriately describes the performance of a supply organisation.

The procedure for working out the safety stock (or reorder level) consist in first choosing a suitable measure of shortage and then specifying the desired service level. Once these are specified using statistical methods. the safety stock to be kept can be worked out easily.

Standardisation, Variety Reduction Etc:

7.29 Standardisation is one of the tools available to management to optimise on the number of items and reduce inventories. With standardisation the number of items to be procured will be reduced and for the same value the quantity will be increased thereby leading to economies of scale and cost reduction. Examples of standardisation from daily life include the bulb capacities, shoe sizes, ready-made garments sizes etc. Lack of standardisation causes problems.

7.30 One of the biggest advantages of standardization is the interchangeability of the parts. Once an item has been standardised, the number of manufacturers who can supply the standard parts will increase and this will result in better availability, lower cost and continuity of supply. The buyers will also have to stock only standard items as he is assured of timely supply. This would enable him to reduce his inventory and cut down the obsolescence. Once an item has been standardised the buyers can reduce the inspection formalities and enter into rate contracts for regular supplies. Thus the advantages of standardisation are immense.

7.31 In our country the problem of standardisation is multidimensional. We have to cope with the indigenous availability of raw-materials imported materials and the importing of technologies from different countries which follows their own standards. In spite of this quite a few companies have standardized and have been benefited. The pioneering efforts of the Indian Standards Institution who have already promoted over 10,000 standards covering raw materials, components and finished products have gone a long-way in reducing the problem of standardisation. The use of the ISI Certification mark is governed by the provisions of the Indian Standard Institution (Certification Marks) Act, and the Rules and regulations made thereunder. Presence of this mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of the standard, under a well defined system of inspection, testing and quality control during production. This system, which is devised and supervised by ISI and operated by the producer, has to further safeguard that the products as actually marketed are continuously checked by ISI for conformity of the standard.

7.32 Quite a few public undertakings/Government Deptts., like the Railways and D.G.S. & D., C.W.C. etc., have appointed high power committees to suggest and implement standardisation. The problem of standardisation are more in capital intensive sector because of the import of technology as compared to the other sectors. The Fortieth Report of Material Management in Public Sector Undertaking gives an idea of the enormous problems due to lack of standardisation. While dealing with variety reduction and standardisation the Committee on undertaking mentions as following.

"Another reason for large inventories in public undertakings was that the items of stores were of multitudious variety. Thus in Oil and Natural Gas Commission it was found that in the same Project different makes of machines were being used for identical purposes. This was true not only of imported machinery and equipment but also of indigenous makes. As an instance in the case of trucks - Bedfords, Fargos and TMBS were all in use simultaneously in most of the projects. The result was that each major project had to stock about 3,000 to 4,000 categories of spare parts pertaining to motor vechicles alone. Similarly, in Hindustan Insecticides it was noted that at the end of 1964-65 there were too many varieties of MS bolts and nuts-44 varieties Drills H.S. (S.S. & T.S.) 36 varieties etc".

7.33 In yet another undertaking, namely, Fertilizers and Chemical Travancore Limited, there were nearly 100 varieties of electric motors. There were too many varieties of tools, oil, paints, enamelled copper-wire electrodes, heat exchangers, pumps, oil seals, valves, ball-bearings, various hardware items, printing and stationery items and so on. There were 26,000 stock items.

7.34 The Committee find that although the public undertakings are conscious of the need for standardisation and certain steps have been taken by some of them in this direction, there is still a great leeway to be made. The Committee, therefore, desire that the matter should be pursued vigorously by the public undertakings in coordination with the Indian Standards Institution of other specialised agencies. They would like to point out that the aim of standardisation should be to have uniform standards for similar items, and the standards evolved should take cognizance of indigenous availability of materials to the maximum extent possible".

What is Standardisation:

7.35 The process of formulating and applying rules for an orderly approach to a specific activity for the benefit and with the cooperation of all concerned and in particular for the promotion of optimum overall economy taking due the account of functional conditions and safety requirements. It is based on the consolidated results of science, technique and experience. It determines not only the basis for the present but also for future development and it should keep pace with progress. Some particular applications are:-

1) Unit of measurement;

2) Terminology and symbolic representation;

3) Products and processes (definition and selection of characteristics of products, testing and measuring methods, specification of characteristic of products for defining their quality, regulation of variety, interchangeability, etc.);

4) Safety of persons and goods.

Standards can be for an individual or an institution or a nation and can become so effective that others also starts adopting them. For example we still follow the I.E.C. (International Electrictechnical Commission) standards for testing the performance of transformers to the extent possible.

Variety Reduction:

7.36 The number of items available for stocking has been growing at a tremendous speed with the improvement in technology. Different items have a different rate of consumption. There may be items which have not moved for more than five years. In organisations which stock more than 5,000 items the problem becomes more. Hence to control the inventory one will have to reduce the variety. Varieties increases because of development of new items as well as change of standards.

7.37 Variety reduction have to be resorted to in three spheres in an organisation:

i) Inputs stage;

ii) Processing stage; and

iii) Out-put stage.

While the reasons for the increase in variety at the in-put and processing stages will be due to demands of the production department, the increase in the out-put stage will be governed by the marketing process.

7.38 The variety usually start growing in number in the small item with low usage. The items like fasteners which are available according to the British and metric standard are usually stocked separately. Similarly, for comparative sizes 2 items will be stored - one may be a B.S. thread screw and the other a metric thread screw. If the organisation standardises on metric unit the varieties can be reduced.

7.39 In the case of work in progress/processing stage the increase in variety will be due to technical bottlenecks. The increase of variety in out-put stage is dictated by market requirements. It may be noted that

BHEL is going to manufacture 220 MW Generating sets giving up the present 120 MW sets and transmission equipment at 400 Kv rating will become the standard. This would result in increase in variety due to technological development. Even in case of consumer products the market will require different sizes and packings- tooth pastes are sold in 3 or 4 packings, bulbs are sold 15W, 25W, 40W, 60W... ratings, shoes are sold in 1 to 9 sizes etc. while sizes of shoes, ready-made garments etc. are standardised on population distribution preferred numbers are used to decide on the variety of packing and other items. The customers prefer a geometric progression of size differences (1,2,4,8,18 etc). rather than an arithmetic progression (2,4,6,8,10 etc). The extreme points are the largest and the smallest sizes to be manufactured. For taking a decision for the total number of sizes the ratio by which the increase is made in a geometric progression is given below :—

$$(r-1) \quad \sqrt{\frac{\text{Largest size}}{\text{Smallest size}}}$$

For example - a manufacturer of motors wants to make 10 H.P. to 1000 H.P. motors and decides in 5 ratings then the ratio is

$$(S-1) \quad \sqrt{\frac{1000}{10}} \qquad = \sqrt[4]{100} = 3.3.$$

The ratings would be 10,33,1000, 330 and 1000 HP (the ratings have been approximated).

In order to obtain maximum benefits, an organisation has used standardisation and variety reduction.

Disposal of Surplus and Obsolete Items:

7.40 The accumulation of stocks of spare parts results in increase of locked up capital, inventory holding cost as well as cost of obsolescence. In the case of River Valley Projects where a time bound programme is followed, substantial stocks of spare parts remain unutilised and undisposed off even long after the completion of the work on which the equipment was deployed. It has been observed that spare parts worth about 10% of the value of the equipment are left as surplus on completion of the project works. In some cases it has taken about 6-8 years to dispose off or rehabilitate about 50-60% of the residual stocks while the balance 40-50% remained as dead stock. In due course of time the spare parts which belong to certain makes and models of machines proved to be obsolete due to equipment of more recent origin having been used on other

projects while the old equipment have completely out-lived its useful life either on the projects where the stocks are held or on other projects where the equipment was transferred subsequently. Thus about 5% of the total stock of spare parts are left as dead stock items with the project.

7.41 Some of the reasons for the accumulation of surplus spares or obsolete stock are as under:-

1. Huge assortment of makes and models of equipment deployed on River Valley Projects.

2. Faulty buying of large quantities to take advantage of quantity discount.

3. Fear of scarcity or delayed availability of critical spares produces a tendency of holding over stocks.

4. Obsolescence of equipment prompts the suppliers of equipment to insist upon users to purchase the spares for the entire life of equipment in one lot.

5. Lack of proper plant planning, Acquisition of equipment based on improper selection amongst other things also result in under-utilisation of equipment and spares. Factors like availability of machines during its entire life, which varies from year to year and replacement of machines which has done about 70% of their life etc.

6. Non-availability of list of interchangeability and commonality of spare parts on projects.

7. Unseemly hurry in procuring old and used machines with spare parts.

8. Lack of advice of competent mechanical engineers at higher levels in regard to plant planning, acquisition of equipment etc.

9. Dissipation of authority of operation and maintenance of construction equipment. Normally the operation of equipment is left under the management of Civil Engineers and the repair is left under the Management of the Mechanical Engineers which results in ordering of spares on speculation basis. Non disposal of surplus and accidented machines which are uneconomical for use or beyond economical repairs and which remain in junk yard for years due to procedural difficulties.

10. Cannibalisation which is resorted to by certain projects makes the unused parts of cannibalised machine obsolete. Wherever a machine break down and there is dearth of particular part it is normally removed from identical machine and fitted on to this machine. If there are 10 identical machines then one of them is cannibalised to supply the spares needed for the other machines. The unused part of cannibalised machine become obsolete inventory.

7.42 In order to bring down the inventory carrying cost, it is necessary that action to dispose off the surplus obsolete spares is taken well in time. All out efforts should be made to transfer the spares comprising both fast and slow moving along with equipment to other needy projects. Secondly the spare parts which are either obsolete or have deteriorated due to long storage should be identified separately and disposed of to the best advantage of the Project.

7.43 In order to liquidate large quanity of surplus spares available at various River Valley Projects the Government of India Ministry of Agriculture and Irrigation (Department of Irrigation) have also constituted a Standing Committee comprising of Senior Mechanical Engineers in the Irrigation and Power Sector which meets regularly at some Projects in the country with a view to rehabilitate the surplus spare parts. It is recommended that the River Valley Project should extend their maximum cooperation to this Committee and make use of its good offices for liquidating the stock of surplus spares held by them. A mini-computer has also been installed in C.W.C. under the charge of Central Mechanical Organisation, for maintaining a record of the surplus spare parts available with the various project authorities. Requisitions received from the various Indentors are fed into the computer and all out efforts are made to communicate the availability of parts in the shortest possible time. Installation of such mini-computers under the C.M.Us in each State for rehabilitating the surplus spares or meeting the emergency demands on loan/transfer basis within the State will be found very useful in reducing inventory carrying cost as well as down time of machines.

7.44 The obsolete spare parts and the scrap should be disposed of by the Project in the best manner deemed fit. It should, however, be noted that in our country there is an established market especially for metallic scrap. Even old news papers and used papers can be sold. The prices obtainable in the scrap market fluctuate in sympathy with the price movement in the primary markets. In order to obtain best price for the scrap it is advantageous to segregate the scrap. It is not very difficult to achieve this because scraps are generated at different points and a coordinated collections in classified bims can solve the problem.

Computerisation

7.45 Inventory Control has of recent become one of the most important aspect in the running of any industry or construction of R.V.P. A variety of information is required for purposes of accounting, planning and control of materials and spare parts.

7.46 For accounting purposes, the informal requirements are the periodical quantities and value of receipts, issues and balances, the differences between book and physical stocks and the consumption cost reports.

7.47 The information requirements for purposes of planning are the maintenance history, procurement lead times, the follow up reports on each spare part from the time order level is reached to the various stages of procurement till receipt, periodical equipment-wise stocks on hand for indenting reviews etc.

7.48 The information requirements for purposes of control are the A B C analysis reports and the inventory variance analysis reports.

7.49 While the accounting information requirements are simple and are capable of manual processing, the planning and control information reports cover complex processing of materials and spare parts movements and levels spread over the entire utility. For processing the voluminous and complex data and making available prompt and accurate reports, computer processing is very much necessary.

7.50 The initial effort required to start computer processing is considerable. The materials and spare parts will have to be coded with regard to the identity and class of each part and fed to the computer with the stock balances. The processing logic and the output requirements will have to be worked out in detail and computer processing tested to make sure that the processing is correct.

7.51 Once the initial effort is over, it would be necessary to feed the periodical stock movements in coded form and the entire processing would be carried out by the computer and the necessary outputs made available.

7.52 Typical computer out-puts are listed below:

a) Accounting

i) Stock Ledger Reports.
ii) Cost Report
iii) Shortage/Excess Report
iv) Annual Inventory List.

b) Planning

i) Review period and Reorder levels data.
ii) Lead time data.
iii) Consumption Analysis.
iv) Indent report of items which have reached re-order level.

v) Indent follow up reports for each stage of procurement of all items.
vi) Special reports on equipment wise stocks of spare parts for review before overhaul.

c) Control

i) A B C Analysis.
ii) Inventory variance analysis reports.

7.53 The benefits of computerisation in materials management can be classified into the following three categories :-

i) More effective control on inventory which should result in a reduction in "stock out" situations i.e., balanced inventory.

ii) Reduction in administrative costs.

iii) Integration with other Project/State functions.

Lastly computers are only a 'Tool' in the hands of Management to be used in effecting decisions but computers can not really make decisions. For an "Effective use of computers", it is necessary that its effectiveness is fully understood and accepted by the users at various levels.

7.54 A computerised Inventory Control system has been developed in Madhya Pradesh in the State Irrigation Department as a whole and has gone into operation in 1979. While achievement of objectives is to be watched, other users could benefit from the classification, codification systems, programmes input and outputs developed.

Conclusion and Recommendations

7.55 1. Inventory Control Cells should be created at all Major Projects and under the CMU's in each State. It should, however, be ensured that all functions of Materials Management like Material

Planning and Programming, Purchasing and Procurement of Capital Equipment, Inventory Control, Stores keeping and Ware-housing, Materials handling and Transportation etc. etc., come under a united direction and answering for efficient working.

2. In order to create awareness amongst the project Engineers they should be imparted training in the Modern system and techniques of Material Management and Inventory Control.

3. The materials and spare parts required at the Project should be classified and coded in terms of their different uses.

4. A B C Analysis should be carried out for separating the significant few from the relatively unimportant many for a proper inventory Control.

5. Proper procedures should be laid out clearly for procurement of stores and quick payment of suppliers bills to reduce the lead time and other delays.

6. Sufficient attention should be given to efficeint Planning and carrying out of the Store keeping functions to minimise the Inventory carrying cost.

7. Immediate action should be taken to dispose of the obsolete Parts and scrap to reduce the Inventory holding cost.

8. Standardisation and variety reduction should be resorted to reduce the number of items to the procured.

9. Sufficient care and thought should be given for procuring the Insurance items.

10. Safety Stock and Re-order levels should be decided carefully on the basis of past consumptions to facilitate timely replenishments.

11. Special Cells in Major Projects should devise procedures for timely shedding of surplus spares and make a concerted effort to collect lists of requirements from Projects using similar equipment and rehabilitate the spares to the maximum possible extent. They should pursue the manufacturers/ suppliers also to dispose of surplus spares if no Government Project needs them.

12. Obsolete equipment beyond economical repairs, accidented machines and spares of obsolete equipment should be disposed of rather than rehabilitated. Disposal committees may be formed in the Project/States for this purpose.

13. In case of purchase of spare parts by the Projects from other Projects, the Direct Demanding Officers at various levels should exercise their normal powers in regard to such purchases.

14. The Engineer in charge should have full powers to release equipments/spares to another Project within the State and the Chief Engineer in charge should have full powers to release such equipments/spares to a project outside the State.

15. The non-finalisation of transfer price should not hold up transfer of equipment and spare parts from one Project/ State to another project/State.

16. Data on stores available and spares required by various Projects should be periodically exchanged particularly before overhauling season. This will assist not only in early acquisition of spares required but also expeditious rehabilitation of surplus spares.

17. Computerisation should be resorted to only at Major Projects and at State level in CMU's for processing the voluminous and complex data for making available prompt and accurate reports.

VIII. PERFORMANCE BUDGETING

CHAPTER VIII
PERFORMANCE BUDGETING

INTRODUCTION:

8.01 It is not the object of this chapter to dwell on the theory and concept of performance budgeting. The object is to attempt a practical approach to performance budgeting in relation to cost control in river-valley projects. Of all the items of cost, the most important is the hidden cost of Time. A delay in completion of a river-valley project not only means a denial of the benefits of the project to the nation for the corresponding period but also an increase in the project cost which is ultimately passed on to the users by way of increased cost or the benefits. Herein lies the importance of cutting down the hidden cost of time. The performance budgeting can be made a meaningful document to assist the management as a tool of administrative and financial control for evaluating performance and implementation of developmental programmes efficiently and economically. While the performance budget works as the tool of the management, at the executive level it is an instrument for checking whether the budget allotment for a particular programme has achieved required physical results and also what is proposed to be achieved at what cost in the ensuing year for which funds are being asked for. Such a budget will not only enable the management to put the scarce financial resources to maximum use but would also be useful in reviewing and appraising the activities and performance of the project in proper perspective. Performance budgeting can be used as an effective tool by the management for control over both cost and time factors.

BROAD SEGMENTS:

8.02 A scheme for implementation of performance budgeting can be divided into three broad segments:-

(a) Formulation and presentation of the budget,

(b) Administration of the budget,

(c) Presentation of the results.

FORMULATION AND PRESENTATION:

8.03 Formulation and presentation of a performance budget will consist of (i) setting out clear and well-defined performance budgetary goals and objectives, and (ii) computation of the inputs in both physical and financial units required for achievement of the objectives and the anticipated output.

8.04 The documents on long-term plans and annual plans of the Central and State Governments and the projects reports will contain the broad objectives. The extent to which these objectives can be incorporated in an annual performance budget will depend on prospective availability of

funds, labour, machinery, materials and land as well as the position of the contracts to be awarded and the contracts under execution. One important reason for delay in construction and consequent increase in cost is absence of detailed planning as regards personnel, construction plant, stores, and materials, planning anciliary facilities required for construction. The problems associated with project implementation and the operation and maintenance of completed project should be anticipated and appraised during planning stage. The sequence of operations and vital activities that are likely to effect the progress need to be identified. Detailed considerations needs to be given to factors which affect the programme.

For success of any venture, it is imperative that a detailed plan of work is chalked out and schedules drawn up; visualising each important activity and taking into account the limitations and inter-relationship of one group of activities with another. In fact PERT/C.P.M. network shall be attempted right from the project formulation stage. Any change in the scope of work owing to change in volume of work or inclusion of new works not foreseen earlier will play an important role in laying down the objectives.

8.05 Computation of inputs, in case of a departmentally executed work, will be made with reference to the objectives of physical targets and the analysis of rates and requirement of tools and plants which will be available in the project estimate. For a work executed through contracts, the contractual output and the cost will be the inputs for the project budget. In both cases, any other item of expenditure not included in the work (e.g. land, establishment cost, suspense etc.) will feature under appropriate heads in the performance budget in financial terms and also, wherever possible, in physical terms. As regards the physical targets of output, these will be worked out on the basis of the budgetary objectives.

8.06 The presentation of the budget should be on the basis of the annual figures divided into monthly or at least quarterly data on physical output and the required physical and financial inputs. The presentation under the budget heads or sub-heads of work may be further sub-divided, in separate statements or schedules, into data for each important components of comparatively small magnitude relating to a particular budget head or sub-head can be grouped together. In order to avoid a cumbersome presentation it is desirable that in case of a departmental work only physical output target and the financial input (and not the physical inputs) should be shown under the works heads or sub-heads. The procurement of stores, tools and plant and engagement of labour which will be the physical inputs for the work can be shown in separate schedules to the budget under broad heads.

8.07 A Project will have to devise its own forms for drafting and presentation of its performance budget. The performance budget documents of the National Thermal Power Corporation (New Delhi) which cannot be reproduced owing to its bulk, can serve as a guide to the projects executed through contracts. It may also be useful to a limited extent to a project executed departmentally.

8.08 In brief, a presentation of performance budget will be based on schedules of activities the achievement vis-a-vis target in the proceeding and current year and physical target for the coming year. The achievements/likely achievements should invariably be compared with the targets or the estimates fixed earlier. The activities will be shown with reference to works estimates/contracts or a group of these estimates/contracts and their anticipated/actual dates of commencement and completion. The units will be financial and wherever possible physical (e.g. area of land, length of roads, area or number of buildings, tonnage of materials, number of machines, volume of excavation and concreting etc). The monthly or quarterly data of cost and anticipated achievement in physical terms will finally end up in an annual total. There will be a budget summary showing the total financial budget and it will be supplemented by schedules of activities and anticipated achievements. The budget summary should also depict the project estimate cost for the budget head or sub-head, expenditure upto the end of the previous budget period and the present projection of expenditure for future years till completion of project. Figures for physical quantities estimated, executed and balance to be executed should also be shown wherever possible. In case of any upward revision of cost of estimates of a project/scheme, the break up of the factors responsible for it should be indicated. Short fall in achievements of physical targets need to be explained in detail.

BUDGET ADMINISTRATION:

8.09 Budget administration which is a link between budgetary objectives and achievements is the most important part of a performance budget. It is through proper administration of a budget and sustained pursuit of the goals that anticipations are translated into achievements, the hidden cost of time is cut down and cost over-run which is often a familiar feature of the projects in an inflationary economy can be effectively arrested.

8.10 For the purpose of administration, an annual budget will need to be divided into monthly or quarterly segments or budgetary periods. The principal emphasis will be on inputs and output. The broad spectrum of a budget administration can be split up into the following areas:-

(a) Planning and action for mobilisation of resources like land, machinery, stores, labour force and funds.

(b) Distribution of the resources over various sectors of

a project and control over their effective use in the best interest of productivity and progress.

(c) Progress planning, monitoring and control.

(d) A review of the critical factors i.e. shortage or non-availability of any item or items of resource, plans and actions to overcome the criticalities and re-scheduling of activities and re-allocation of available resources from sectors of comparatively low priority to those of top priority.

8.11 A watchful eye, a critical analysis, sustained pursuit and a capacity to distinguish the consequentials from the inconsequentials should be the keynote of the administration of a performance budgeting. Any system of control and sustained pursuit has two essential pre-requisites, (i) collection of information from functional area, and (ii) a critical analysis of the information and projection of the present trends into future trends.

8.12 The information which should relate to only what is essential and avoid massive details can be presented through statements on data, bar charts or colour bands. The following are some of the functional areas which will be sources of information for the purpose of control and progress chasing:-

(a) Land acquisition.

(b) Procurement of materials, machinery and spare parts with special reference to pre-order and post-order stage.

(c) Working of the machines, shut-down hours, preventive maintenance.

(d) Mobilisation of officers, staff and labour force, their distribution (and phased reduction towards the closing stage of a project).

(e) Disposal of surplus machinery, stores and spares in the closing stage of a project.

(f) Arrangement for funds.

(g) Factors responsible for cost over runs or escalation elaborated in sufficient details explaining why correcting mechanism failed to arrest the trend.

8.13 The control statements containing the information will be subjected to a critical review and corrective actions will be initiated in order to arrest short-falls. Action to overcome critical factors, re-

scheduling of activities and re-allocation of resources, where necessary, will arise at this stage.

8.14 A project should devise its own forms for collection of information. While day-to-day review and control should be the responsiblity at a divisional level, a monthly review is recommended at the level of a construction circle and a quarterly review at the level of Chief Engineer/ Chief Executive of a project. Whenever a criticality has arisen or is foreseen it should be reviewed at an appropriate level where decision-making will be possible. Corrective actions have to follow review in all cases if the performance budget is to be meaningful. If performance budgeting is to be successful there should be active involvement of all agencies concerned.

PRESENTATION OF RESULTS OR ACHIEVEMENTS:

8.15 Presentation of achievements on completion of an annual budget period may follow the same pattern adopted earlier for presentation of the budget before commencement of the budget period. In the stage of presentation of achievements, the monthly or quarterly data should be avoided and only the data of a physical output and their cost for the year together with anticipated and actual dates of completion, reasons for shortfalls or cost overrun etc., should be presented under budget heads or subheads. The provision in the project estimate for physical output and cost, any revision of these items foreseen later on, the balance of left over work, funds available with reference to estimate and expenditure, forecast of funds requirement on the basis of uptodate assessment of the balance work should also be shown in the summary of achievements under budget heads or sub-heads. The presentation of all these data may require division of the summary document into two parts.

8.16 It is assumed that the authority to whom the summarised form of achievements of performance budget is presented will review it critically, give decisions or directions wherever needed and watch the follow-up actions.

IX. STRUCTURE AND FUNCTIONS OF COST ACCOUNTING CELL

CHAPTER IX

CREATION OF COST CONTROL CELLS ON PROJECT

9.01 Since independendence, a large number of irrigation and multi-purpose projects have been taken up for construction in the country. While the benefits of irrigation accruing from these projects have greatly helped in increasing agricultural production in the country, the mounting costs and the frequent revision of the project estimates and consequent delay in the completion of the projects and accrual of the benefits therefrom have been causing great concern to the Government.

9.02 Whenever there is a substantial revision in the original estimate of a project many thoughts appear in public mind. Criticism is voiced that projects are not properly conceived and formulated. One also hears about the projects being planned and executed not being economically viable. That the above criticism is valid to a varying degree in some cases cannot be denied. All these criticism resulting from increases in project costs, which are occasionally huge, stem from inadequate appreciation of the procedures involved in the framing of project estimates and the factors which are responsible for cost escalation. In 1972, the Government of India set up an Expert Committee to examine the reasons for rise in the costs of irrigation and multipurpose projects.

9.03 In its report submitted to the Government of India in April, 1973, the Expert Committee identified the important reasons for the increase. The Committee has observed that real drawback is in the preparation of the estimates and in that respect it has recommended a number of measures. One measure which is very important for exercising proper control over construction costs on a project is the need to have a regular and continuous system of cost analysis of major construction operations on the project with a view to spot and eliminate inefficient construction procedures and to rectify the drawbacks in working which contribute towards increase in costs.

9.04 Of course, when the construction of a project is done entirely through contractors the second and third stage of analysis would not be very significant. But even where the work is done departmentally it has been observed that the running costs are not always maintained and the analysis of item rates at completion of the projects are never done. The Committee felt this to be a major drawback which need rectification and also felt that there is great need for creating awareness of the fact that efficiency and out-put can be improved and the cost cut down by keeping a proper record of running costs and maintaining a system of regularly analysing and reporting them.

ACTION TAKEN AND RESPONSE FROM STATES:

9.05 The Expert Committee on rise on cost of irrigation and multipurpose projects among other recommendations had recommended the establishment of cost cells. These recommendations nad been circulated to various State Governments.

9.06 In pursuance of the resolutions of the First Conference of State Ministers of Irrigation held on July 17-18, 1975, the setting up of cost control cells for all major projects was commended to all State Governments. Since not much of progress had been achieved in this regard, the Second Conference of the State Irrigation Ministers held on 10th and 11th Sept., 1976 again commended to the State Governments for taking expeditious action to set up cost control cells on all major projects costing 30 crores or more. It was considered necessary that to enable to discharge the functions of Cost Control Cell effectively, each of the Additional Chief Engineer/Chief Engineer in charge of River Valley Project should have independent Cost Control Cell. The structure of the cell could be as under:-

Executive Engineer	One
Assistant Engineer	One (per Circle)
Costing Engineer (Senior Assistant Engineer)	One

Supporting technical, Ministerial staff i.e. Junior Engineers, Stenographers, typist etc.

One small cell at State level to coordinate the work of project level cost control cell and for compiling the information from all cells and disseminate the same in respect of Cost Control studies was also suggested having structure as under:-

Deputy Secretary (Cost Engineer)	One
(Senior Assistant Engineer)	Two
Statistician	Two

9.07 It is seen that except for a cell in Kerala State Electricity Board, and Haryana Irrigation Department, the cost control cells do not seem to have been established on any of the on-going projects.

9.08 Costing as an aid to cost control in river valley projects has considerable scope and possibilities. But, introduction and meaningful functioning of costing in a river valley project is likely to be surmounted with practical difficulties of a first degree magnitude. Keeping in view the nature of difficulties which are likely to be encountered, a

practical approach has been made.

SOME ESSENTIAL PRE-REQUISITIES:

9.09 The main function of the cost cell will be prompt collection of fairly accurate data of actual cost of different works, comparison of the actuals with the estimates, highlighting the significant variances and their reasons so that either corrective measures for cost control are adopted in time or, where circumstances justify, the estimated unit rates are revised to bring them in line with the acutals.

9.10 In order to compare the actual cost per unit with the estimated cost, every work, sub-work and detailed work in the project estimate should be allotted a cost code number; there should be a unit rate for each detailed work and the components (labour, material etc.,) of the unit rate should be available in the analysis of rates. At present, the analysis of rates is available for some important items only and there are instances where lumpsum figures are adopted for certain items in the project estimate. It has to be appreciated that it is the system of cost code numbers and analysis of rates resulting in a unit rate which establish a meaningful link between the actual and the estimated cost.

9.11 The annual works budget, which itself reflects on escalation in cost compared to the project estimate figures, will have to be based on a list of the detailed works together with their cost code numbers, volume or quantity of each detailed work and the unit rate together with a fresh analysis of rates adopted for the year to which the annual works budget pertains. This is essential because a comparison of the actual cost with the latest analysis of rates on which the annual budget is based will be far more meaningful than a routine comparison of the actual cost with the estimated cost as per the project estimate which was prepared several years ago and would have lost much of its cost significance owing to inflation during the intervening years. An annual revision of each analysis of rates for budget purposes and for subsequent comparison with the actual cost may at first seem to be a formidable task. But, once an analysis has been done on a comprehensive basis, the subsequent up-dating from year to year should not be much of a problem. It is expected that the quantity of inputs in analysis of rates will not change significantly; the main changes will be on account of increase in cost of the in-puts.

9.12 No purpose whatsoever can be served by costing unless the quantity and the value of out-put are known. In case of works entrusted to contractors, there is a system for measurement and evaluation of the periodical out-put. In works executed departmentally, the system of periodical measurement and evaluation does not exist and whatever expenditure is booked periodically against a work is regarded as the value of whatever quantity of the work might have been executed. Even the materials which have been issued to works but not yet converted into work-in-progress find their value reflected in the cost of works under execution.

It is essential that in departmentally executed projects a system for monthly measurement of works should be introduced. The measurement should be in respect of each detailed work which is under execution.

ESTIMATE COST ACCOUNTING:

9.13 A very important point for consideration is whether a separate set of cost accounts should be maintained in a river valley project in addition to the financial accounts. It is to be borne in mind that works register which form a part of the financial accounting system exhibit the cost of works against different estimates under various headings like material, labour machine-hour etc. Hence, a question arises whether a separate set of cost account will not be an avoidable duplication.

9.14 It will be better if the costing in a river valley project is done on the principles of estimate cost accounting system which is widely used by building and construction agencies. According to this system the cost cells should lay considerable emphasis on the estimated unit rates of work which will form the basis of the annual budget. The actual cost data will be collected from the financial accounts in the works register. The next step will be the analysis of the variances between the estimates and the actual and, finally, suggestions on corrective measures. However, the adoption of the system will call for certain improvements in the existing pattern of works register. The booking of expenditure should be against detailed works each of which will have a specified cost code number. The present system of booking of expenditure for various works under a common estimate will not do. Another important provision which will need to be made will be in respect of the quantity of the units of work completed during a month and also the evaluation of incomplete units in terms of complete units. Incorporation of this figure of complete units and units in progress will enable calculation of cost per unit. It is felt that if the changes suggested above are introduced in the works register it may be possible to get the purpose of cost control served without maintaining a duplicate set of accounts in the costing branch.

STRUCTURE FOR COST ACCOUNTING CELLS:

9.15 There should be an apex cell in each State dealing with co-ordination of the activities of costing in individual projects in the State. In order to assist the project authorities to determine and control cost, it is essential to have independent "Cost Accounting Cell" with each project and a cell with each sub-project if the exigencies of the work demand.

The "Cost Accounting Cells" shall be thus at two levels:

-(State) Cost Accounting Cell

-(Project) Cost Accounting Cell - with cells at each of the sub-

projects if necessary.

The cells should be staffed with adequate number of qualified Cost Accountants, Engineers, Assistants and Professionals.

9.16 (State) COST ACCOUNTING CELLS: shall have the following set up:-

(i)	Chief Cost Analyst	In the grade of Superintending Engineer or equivalent
(ii)	Cost Analyst	In the grade of Executive Engineer or equivalent
(iii)	Assistant Cost Analyst	In the grade of graduate Junior Engineer or equivalent
(iv)	Professionals	In the grade of Diploma - Junior Engineer or equivalent
(v)	Supporting Staff:	Clerks, typist etc.

Qualifications & Experience:

i)	Chief Cost Analyst	A cost accountant & shall be a member of the Institute of Cost and Works Accountants of India or Member of I.C.M.A. or an Engineer with long experience of costing.
ii)	Cost Analyst:	Deputy Cost analyst with 5 years experience in the grade.
iii)	Assistant Cost Analyst:	Graduate in Engineering - or Intermediate Cost Accountant - or Professionals with 5 years experience
iv)	Professionals:	Statisticians/M.A. (Economics)/M.A. (Statistics)

9.17 (Project) COST ACCOUNTING CELLS: shall have the following set up:-

(i)	Chief Cost Analyst	In the grade of Superintending Engineer - when annual outlay is more than Rs. 15 crores.
	or	
(ii)	Cost Analyst	In the grade of Executive Engineer when annual outlay is less than Rs. 15 crores.

(iii)	Deputy Cost Analyst	In the grade of Assistant Engineer - one for every Rs. 5 crores annual outlay.
(iv)	Assistant Cost Analyst	In the grade of graduate Junior Engineer - one for every Rs. 5 crores annual outlay.
(v)	Professionals	In the grade of Diploma Junior Engineer - one for every Rs. 5 crores annual outlay.
(vi)	Supporting Staff	Clerks typist etc.

Qualifications and Experience:

(i)	Chief Cost Analyst.	A cost accountant and shall be a member of the Institute of Cost and Works Accountants of India or member of I.C.M.A. or an Engineer with long experience of costing.
(ii)	Cost Analyst	Deputy cost Analyst with 5 years experience in the grade.
(iii)	Deputy Cost Analyst	A cost accountant, having completed final examination of I.C.W.A.I. or I.C.M.A. or Assistant Cost Analyst with 5 years experience in the grade or Assistant Engineer with Costing background.
(iv)	Assistant Cost Analyst	Graduate in Engineering - or Intermediate Cost Accountant - or Professional with 5 years experience.
(v)	Professionals	Statisticians/M.A.(Economics)/ M.A. (Statistics).

9.18 (Sub-Project) COST ACCOUNTING CELL: These may be provided depending on exigency of the work and shall have the similar set up as (Projects) Cost Accounting Cells:

Expenditure limits:

9.19 The expenditure on Cost Accounting Cells shall have to be limited to 1% of the works outlay of which 0.1% shall be for the cell at the State level and 0.9% for the cell at project level.

FUNCTION OF COST ACCOUNTING CELLS:

9.20 The functions of the cost cells will fall under three broad categories:

(a) Collection and analysis of the costs incurred in execution of the works.

(b) Computation of the cost of various activities.

(c) Comparison of the actual costs and actual quantitative progress with those in the annual budgets and in the original/ latest revised project estimate, and carrying out cost benefit analysis and investment effectiveness studies.

With passage of time, the need as well as the scope of the work that Cost Accounting Cell may have to perform might considerably increase. The functions as can be identified at present are as under:-

1) Collection of data of Cost.

2) Cost determination of individual activities and the project as a whole.

3) Measurement of completion of individual activities and the project as a whole.

4) Cost Analysis and performance analysis.

5) Variance Analysis (Actual Vs. Budget).

6) Reviewing the costs and revising the Budget estimates.

7) Preparation of performance budget.

8) Updating the network and preparing crashing schemes.

9) Working out the - Labour outputs, productivity equipment outputs under varying job conditions, so that standards for such outputs are laid down:

10) Analysing the rates of all important items so that construction cost indices can be established for labour material machinery, fuel, etc.

11) Collecting and compiling details of actual costs of distribution system, separately for distributaries, minor and water courses with a view to using this data for future project estimates.

12) Initiation and coordination of time and motion studies and scrutiny and compilation of the data of such studies.

13) Reviewing the cost of the project and preparing annual projection of likely cost based on data on actuals.

14) Conducting cost benefit analysis and investment effectiveness studies.

SYSTEM OF COSTING:

9.21 ACTIVITY-ANALYSIS: Activities in a project are the time and resources consuming parts. For the purpose of determining and controlling the cost of the projects, it would thus be ineffective to take the project as a whole.

The whole project is to segregated into its component activities and for each such activity cost records are to be maintained.

So for each project is concerned a time-scale version of complete network, analysing all the activitiss, is to be prepared for the purpose of:-

- Performance budgeting,
- cost determination and variance analysis,
- cost control,
- management information.

With the progress of the work, cost records are to be made for computation of ACTIVITY COST for the period and at the end of the period such costs are analysed with the budget.

CODIFICATION:

9.22 The essential pre-requisite of codification of the works has already been discussed in para (9.10). Two other pre-requisites for any system of costing are codification of the various items of stores and spare parts and a codification for the various items of expenditure and receipts. The code numbers should invariably find mention in the various basic documents like expenditure vouchers, cash receipts, stores issue vouchers, stores return notes, sanction to estimates, details of works for annual budget etc. A specimen of the Cost code number allotted to certain works in Beas Project has been given in Annex. XII. The specimen is by way of illustration only and is not comprehensive.

9.23 Numerical Account Numbers for Decimal system of Cost classification as recommended by I.S.I. in their "Guide for preparation of estimate of River Valley Project - I.S.4877-1968" could perhaps be conveniently adopted for the classification of accounts on all projects for identical type of work or functions so that the cost and rates obtained for them are comparable without special effort being made to reconcile the two sets of figures. New codification for cost accounting may be made (by adding activity code to existing codes for accounting as the suffix or prefix).

MATERIALS, SPARES AND ACCESSORIES:

9.24 It is not considered necessary to discuss the procedural aspects of materials costing on the basis of stores issue vouchers and materials return notes which should be familiar to those who are acquainted with elementary aspects of costing. More important are the practical problems which are likely to arise. One of the problems relates to the practice in which executive officers, in their anxiety to hasten the progress of works, directly purchase the materials and use them in works without routing the papers through the stores. A problem of allied nature relates to the practice of removing materials lying in stores depot and awaiting acceptance. Introduction of a sense of discipline is called for in such cases. The minimum that needs to be done is that the indentor or the user should send an intimation to the stores branch as well as the priced ledger section about the code numbers, brief description, price and quantities of the materials concerned immediately when occasions arise for use of stores without completion of formalities of routing the transactions through the stores branch. On receipt of such intimation from the indentors or the users the priced ledger branch can raise adhoc issue vouchers for the purpose of costing. Subsequently, when the transactions are regularised and formalities are completed, the issue rates may be changed, if necessary. However, the best course should be to minimise such transactions as far as possible.

9.25 A problem of equally great magnitude relates to the delayed and erratic despatch of receipt vouchers and issue vouchers by the stores branch to the priced ledger sections. Materials form the major component of cost for various works. At present the booking of materials is often in arrears or inaccurate since the goods receipt vouchers are not received in time in the priced ledger section or the receipt vouchers come long after the issue voucher have been received or the postings in the priced ledger section remain arrears owing to various reasons. It is essential that the stores branch should pay due attention to the importance of timely despatch of receipt and issue vouchers. One of the practical steps to ensure this may be to staff the stores branch with adequate number of experienced staff. If the posting in price ledgers is in arrears or is erratic, the cost cells can never play the role assigned to them, unless there is a positive improvement in the situation, prompt and

accurate costing will be impossible.

9.26 A third problem relates to the deficiencies in the priced ledger section itself. In order to expedite the postings, use of simple calculating machines will be of great help.

COST ACCOUNTING & METHODS:

9.27 Material: All materials used in the project shall be classified as:-

(a) Direct Materials: Which are actually consumed in the project and physically embedded in it; (e.g. cement, steel, bricks etc.)

i) Proper records shall be maintained showing separately the quantity and cost of direct materials used for each activity of the project.

ii) The valuation for issues shall be recorded on "Weighted average" basis.

(b) Indirect Materials: Which do not get into the final project but only assist in the work, (e.g. consumables, lubricants, etc.)

i) Record shall be maintained for all issues for individual activities. In case of issues jointly for more than one activity, apportionment for different activities shall be made on technical estimation.

ii) Valuation shall be on the basis of "weighted average" method.

(c) Tools, Spares and Accessories:

i) Records of all issues made shall be maintained for each machine or equipment; and the cost shall be apportioned on the basis of servicetimes to each activity.

ii) Valuation shall be on the basis of "weighted average" method.

(d) Wastages, Spoilages, rejections, losses, etc. of Materials:

i) Proper records, showing reason, shall be maintained, showing the quantity and cost of wastages, spoilages, rejections, losses of direct materials, tools, spares, etc., whether in storage or in process or transit.

ii) The total waste record shall be made separately and shall be apportioned to different activities on some suitable basis.

iii) Abnormal losses shall not be charged to activities but shall be recorded separately.

SALARIES AND WAGES:

9.28 The system of effective control over utilization of man-hours with help of time recording clocks installed at the gates of various shops in a factory can not be adopted for control over man-hours in a river valley project where most of the works are carried on in an open area. Therefore, control over utilisation of man-hours can be ensured essentially by a close and effective supervision supplemented by occasional surprise checks, especially in night shifts, by senior officers. The booking of man-hours to various Jobs in project will be done through Job cards. Proper records shall be maintained to show the time and earning of all employees directly engaged for individual activities and also for services (e.g. Machine shop, machine operations, maintenance etc.). The record shall also indicate separately for each activity and other works:-

i) Permanently employed labour for different type of functions (e.g. earth moving, masonry etc.)

ii) Contractor's Labour (e.g. earth removing, masonry etc.)

iii) Casual and other labour (e.g. earth removing, masonry etc.)

iv) Idle time, with reasons, shall be recorded. Abnormal idle time shall be recorded separately with reasons and shall not be charged to any activity.

AVERAGE HOURLY RATES:

9.29 The costing of man-hours on the basis of wages sheets will present no problem if the working hours of an individual employee are allocated to only one or two jobs in a month. However, if the daily hours of an individual employees are allocated to several jobs and such cases are large or if the same employee is shifted to several jobs in a month even though his daily hours are allocated to a particular job, distribution of the direct wages to various jobs will be a problem. In such cases perhaps the average hourly rate may be easier to adopt and may also be used for the purpose of computing Labour Cost. It has to be ensured that the same method of valuation is persistently followed for the project.

9.30 Average hourly rates may be worked out every half year on the

basis of actuals of preceding half-year (April to September and October to March) for evaluating the time booked to jobs. The unabsorbed difference between the actual amount of wages paid and the amount allocated to works for the first half-year can be taken into account for working out rates for the second half-year but the unabsorbed amount for the second half-year should be adjusted to "Under and over Charges - Overheads". These rates are to be worked out separately for different categories of workmen viz., Highly-skilled, Skilled, Semi-skilled and Unskilled according to the following formula:

$$A = \frac{W}{H}$$

Where

A - stands for the average rates;

W - stands for wages etc., and

H - stands for the number of hours of attendance, number of hours of leave with full pay and paid holidays and half the hours for leave on half-pay.

A synopsis of the procedure for booking of direct wages to various jobs which is prevalent in Beas Project is appended as Annex. XIII. This will throw some light on the detailed procedure for booking labour cost in Register of Works. The procedure will suit cost accounting also.

SERVICE DEPARTMENT EXPENSES:

9.31 Detailed records shall be maintained to indicate expenses incurred for each service department. These expenses shall be apportioned to other services and/or activities on an equitable basis and applied consistently.

9.32 Utilities: Records of all utilization like power generation, etc., shall be maintained, for quantity and cost. In case of purchases of utilities, proper records to show such expenses shall be maintained. The cost of utilities consumed by various activities and service centres shall be recorded. Where direct recordings are not available apportionment on some technical estimates shall be made.

WORKSHOP/REPAIRS AND MAINTENANCE:

9.33 (i) Proper records showing the expenditure incurred by the workshop under different heads and on repairs and maintenance by the various departments and the "activities" of the projects shall be maintained. The record shall also indicate the basis of charging the workshop expenses to different service departments and project activities.

(ii) Expenditure on major repair of any asset from which benefit is likely to occur for more than one financial year shall be shown separately in the cost records indicating the method of its accounting in determining the cost of the different projects activities performed during the accounting year. However, where major overhaul/repair charges are booked to a special reserve built by charging a small percentage to machine hour rates every year, the expenditure will be met out of the reserve.

(iii) Expenses incurred on works of a capital nature (excluding expenditure on project activities) shall be capitalised. The cost of such jobs shall include the expenditure on material, labour and a share of the overheads.

DEPRECIATION:

9.34 Proper records shall be maintained showing the cost and other particulars of fixed assets in respect of which depreciation is to be provided. These records shall inter alia indicate the cost of each item of assets, including installation charges, if any, the installation and the rate of depreciation.

9.35 In respect of these assets, the original cost of acquisition of which cannot be ascertained without unreasonable expenditure or delay, the existing book value shall be taken as the value. Depreciation of any assets used for a particular activity shall be charged to that activity. Depreciation on common assets (like plants, equipments, etc.,) shall be apportioned to the activities on the basis of estimated time of use.

OVERHEADS:

9.36 At present some but not all items of over-head expenditure in a project are allocated to the works. The issue rates for materials are loaded with a certain element of over-head and the depreciation, repair and expenditure on running and maintenance of special tools and plants are charged to the works through machine-hour rates. However the over-head expenses on special over-heads, establishment etc., are not allocated.

9.37 A question arises whether it is at all necessary to widen the scope of absorption of over-head expenditure by the works. The output in a river valley project is not saleable commodity but a national asset. Therefore, the only purpose which will be served by inclusion of a wider category of over-head expenditure will be comparison of the unit cost of work in a project with that in other projects and in the private sector.

9.38 The distribution of over-heads in a Government accounting system

will meet with some difficulties. In the system of Government accounts, there is no provision for accounting of the future liabilities which will arise from retrenchment benefits payable to the workcharged labour when the construction will come to a close. There is also no system for operation of deferred expenditure account under which any unusually heavy expenditure incurred in a year is spread over several years for the purpose of booking to the accounts. Further, there is no provision for depreciation of roads and buildings, furniture, fixtures etc., in the Government system of accounts.

9.39 The question of distribution of over-heads will have to be considered keeping in view the pecularity mentioned above. The following suggestions are offered:-

(i) Proper records shall be maintained showing the various items of expenses comprising the over-heads at the project site.

(ii) Allocable overheads shall be directly allocated to particular project activity and the balance shall be apportioned amongst all project "activities"which acquire benefit from such expenses.

(iii) Social welfare cost to workers shall form part of the overheads.

(iv) Depreciation on the township (including schools, roads etc.) expenses and the corresponding maintenance expenses shall be included in the general overheads.

(v) Recoveries from sales of stores, spare, plant etc., unless specifically connected with a particular activity shall be credited to general over-heads.

(vi) Rehabilitation cost and the land cost for rehabilitation shall also be apportioned amongst all project activities on the basis of budget estimates of the activities. Cost of rehabilitation loan shall not form part of overheads.

(vii) Research expenses for the project shall form a part of general overheads, unless specifically incurred for any individual activity.

(viii) Interest on investments shall be recorded separately and shall not form a part of overheads. The interest received against rehabilitation loan shall also be recorded separately.

Reconciliation:

9.40 The total financial expenses of the accounting period shall be reconciled with the total of all activity costs for the period.

RECORD OF PHYSICAL VERIFICATION:

9.41 Records of physical verification shall be maintained in respect of all items held in stock, such as direct materials, indirect materials, stores, tools, spare parts etc., as well as fixed assets including plants and equipments. Reasons for shortages or surpluses arising out of such verification shall be indicated in the records.

9.42 All normal variations shall be adjusted with the general overheads. But abnormal variation shall not form part of cost and shall be reported separately with reasons.

PERFORMANCE MEASUREMENT:

9.43 The criteria for performance measurement should not only be cost efficiency but also physical achievement. Once a system is introduced for measurement of the completed units of works as well as units in progress, it should be possible to measure the actual achievement in relation to the budgeted achievement for the year. A comparison of the cumulative achievement with the cumulative target will be a logical conclusion of the process of the comparison. Analysis of variances and their reasons and suggestion on corrective measures will be the next step. Adoption of corrective measure will be the final outcome. Records of physical verifications of all project activities for estimating the progress of work of such activities shall be maintained by the cost accounting cell.

STATISTICAL RECORDS:

9.44 Data shall be maintained in the cell at State level to enable control of current costs and estimation of cost of future projects.

COST STATEMENTS AND MANAGEMENT INFORMATION:

9.45 The data that may require to be presented periodically shall comprise of:-

(i) Total cost of all activities finished or partly finished during the financial year shall be compiled and the technical estimates of physical progress of all partly finished activities at the end of that year shall be made.

(ii) The budget expenses of the activities for the year shall then be compared with the actual and the variances shall be analysed, recording reasons therefor - vide table II at annexure XIV.

(iii) Periodic cost statements with variance analysis, along with the reasons of variations, shall be submitted by the lower cost accounting cells, upwards, covering the whole of the area of operation.

(iv) Frequency of reporting shall be determined by the State Cost Accounting Cell.

(v) The proforma of reporting shall be similar to that above in the Table I enclosed.

RESOURCE ALLOCATION:

9.46 When resources shall not be available as per requirement, it shall be necessary to fix the available resources to different activities having no "floats". This shall be done after "updating" the network.

CHASING:

9.47 When extra resources shall be available at any time, the cost accounting cell shall also prepare reports, suggesting time-crashing so as to get benefit of lesser time-costs(e.g. machine depreciation, insurance, etc., and inflation cost.)

CONCLUSION:

9.48 In order to perform the functions of the cost accounting cells smoothly, it shall be necessary to arrange for training of all encumbants of the cost accounting cells in Cost Accounting, Network Analysis, CPM and PERT, performance budgeting, and also in M.I.B. The data could be presented periodically to higher Management in the form of graphs showing (i) the actual performance vis-a-vis budgeted sanctions and the original budget estimate (ii) Cost over run and (iii) time lag in the performance. The specimen of the graphs are given in the appendix.

X. PERFORMANCE AND OUTPUT OF INDIGENOUSLY MANUFACTURED/IMPORTED EARTHMOVING MACHINERY

CHAPTER X

Performance and outputs of indigenously manufactured/ imported earthmoving machinery.

Introduction:

10.01 The most economical way to use construction equipment is to convert the potential for work to completed construction as early as feasible i.e., at a high utilization rate. There is an imperative need to improve overall efficiency of equipment management involving many factors such as selection of equipment, equipment utilization planning, personnel training, trained and experienced supervisors, maintenance facilities, preventive maintenance and repair, and parts supply.

10.02 Complete emphasis should be laid on the fundamental need to achieve the required equipment production hours rather than the piece of equipment. Following factors other than initial cost have a significant effect on the benefits resulting from purchase of equipment:-

i) Work capacity of equipment keeping into consideration weights and horsepowers.

ii) Reliability

iii) Maintainability

iv) Capacity of distributor to provide parts, service, training and technical information.

v) Operating costs.

vi) Economic life.

10.03 Central Water Commission estimated that less than 50% of construction equipment in India is operable, of which a good portion is underutilized, resulting in very low productivity figures considering equipment population figures on projects individually and in the country on overall basis, increased investments and excessive cost of work. There is much room for improvement in both the serviceability rate of equipment and the schedules for utilizing serviceable equipment.

10.04 The urgency for development of improved management of construction equipment is supported by the requirement for economy in foreign exchange and rupee expenditure as well as by the requirement for prompt completion of projects to augment nation's food supplies, power production, industrial output and to raise the standard of living. Objective

of improved management is to achieve the required rate of productivity by construction equipment, a rate which should be considerably higher than that being achieved at present.

Classification of Construction Equipment:

10.05 There are large varieties of construction equipment used on River Valley Projects. The equipment can be classified as Standard Equipment.

Equipment which can be used in general on various types of jobs and which are produced as per the standard specifications of a particular manufacturer is called Standard Equipment. Shovels, Dozers, Dumpers, Scrapers, Mixers, Pumps, Compressors etc. in specific sizes are termed as Standard Equipment.

There are other equipment which are manufactured to suit a given job condition. For example, a Mole for excavation of Tunnels, Tower Cranes, etc. These are classified as Special Equipment.

Based on specific use, the equipment can be further classified into following categories:-

1. Excavation Equipment e.g. Shovels, Dozers/Rippers, Scrapers.

2. Haulage Equipment: e.g. Dumpers, Belt Conveyers, Cable-ways.

3. Compaction Equipment: e.g. Sheep Foot Rollers, Vibratory Plain/Pad-Foot Rollers, Vibrators.

4. Concreting Equipment:-

   i) Aggregate Classification & Screening Plants.
   ii) Batching & Mixing Plants.
   iii) Concrete Carrying Equipment.
   iv) Equipment for placement of concrete.

5. Tunnelling Equipment:-

   i) Excavation : Jack Hammers, Drifters, Tunnelling Machines, Moles.

   ii) Mucking : Loaders, Locomotives, Tip Wagons

   iii) Concreting : Transit Cars, Concrete Placers, Concrete Pumps

   iv) Ventilation: Compressors, Blowers.

6. Transport Equipment : Trucks, Tippers, Tractor Trailers, Trailers.

7. Misc. Equipment : Graders, Cranes, Compressors, Fork Lift Trucks.

Construction Plant Planning:

10.06 India has made remarkable strides in the field of Irrigation & Power development. A number of Projects have been constructed to bring vast tracts of uncultivated lands under Irrigation and generate power to remove poverty and bring prosperity in a big way in the country. Since plenty of labour resources are available in the country, the present trend is on labour intensive programmes. But no matter how big or small a project is, use of machine is inevitable in certain areas where specific targets have to be achieved involving long lifts and leads which are beyond labour capacity.

10.07 The efforts of Engineers are directed to design and construct a project which will give the desired results at minimum possible cost. The experienced Engineer, after studying the project, carefully selects the methods and equipment that will produce the greatest construction economy. There have been continuing improvements in construction equipment manufacturing industry with more and more sophistication and with better availability and a higher productivity. The Engineers must keep abreast with such technological developments to keep the construction costs low. Use of sophisticated equipment is capital intensive. Therefore, it is necessary to maintain adequate controls over the construction machinery through periodic reports showing progress achieved, costs and other necessary information in the form of regular returns which make performance monitoring easy and meaningful.

10.08 The cost of equipment on projects involving earth, rockfill and composite dams is sometimes as high as 15% to 25% of the cost of projects depending upon the available facilities, local conditions and type of construction involved. The large investment proposed in the Sixth Five Year Plan on Irrigation and Power is of the order of Rs. 10,000 Crore and Rs.23420 Crore (out of which Rs.4050 crore is for Hydro Electric Projects) respectively. The total outlay for Irrigation & Hydroelectric projects which involve use of earthmoving and construction equipment, works out to Rs.14050 crore. Assuming an average provision of 10% towards equipment and 10% of equipment cost towards spares, the total procurement of equipment and spares in the plan period will be of the order of Rs.1405 crore and 140 crore respectively.

10.09 The basic concept when a user buys equipment is that he does not pay for the equipment but the equipment must pay for itself by earning more money than the investment. It is, therefore, of utmost importance

that due attention should be paid for the selection of equipment after careful planning, from the point of view of suitability, adequacy and realistic production, assumptions and estimates, and post project utilization with a view to achieving optimum utilisation. The objective is to spot out major lacunae in the time and cost estimates which may throw out the economic viability of the Project. The question is how best to utilise the men and machines to reshape or move the earth in the quickest way and at the lowest cost. Work on some of the gigantic projects like Bhakra and Hirakud Dams, which involved several lakh cu. ft. of placement in a day with long lifts and leads, could not have been completed without the use of machines. The very nature of mechanisation allows a greater degree of planning as regards cost, production, work methods, coordination.

10.10 Selection of Equipment: While each Project has to be evaluated on its own merits regarding the use of equipment versus manual labour large Projects can generally be accomplished quickly and at less expenses if right type of machines are employed, maintained and efficiently operated.

10.11 Some of the important factors which will influence the selection of construction equipment and must be observed are enumerated as under:-

1) Type of material: rock, clay, sand, gravel, loading compaction characteristics and weight, etc.

2) Quantity of each material, total volume in cu. m,

3) Distances to be pushed or hauled (Leads).

4) Steepness and direction of grades.

5) Footing for traction and floatation, rough, slippery, wet, soft, loose, firm, smooth, sharp, abrasive, etc.

6) Weather conditions in the area that may affect equipment operation or reduce number of normal working days.

7) Time to complete the job.

8) Space available for equipment to work.

9) Relative cost saving importance of speed and mobility in going from one work to another on the project.

10) Auxiliary machines required for maintaining haul roads, assisting in loosening, loading, dumping & compacting materials.

11) Local altitude & temperature for correcting per hour output.

12) Accessibility of the Project site.

13) Suitability of the equipment for other uses after completing the project.

14) Capacity of supplier for performance oriented service, prompt spare parts supply and problem solving.

15) Specific functions and limitations of the machine,

16) Least unit cost of work.

17) Post Project utilisation.

10.12 It is necessary to establish some suitable system for proper planning of equipment well in advance. The use of construction equipment having higher capacities, higher efficiencies, higher manoeuvreability and lower operating costs will reduce the overall construction costs of the Project. It is essential to exchange technical information with other Projects who have used such equipment already or a consulting organisation like the Central Water Commission and work out the requirement of equipment on realistic basis to suit the needs of the Project. The inter-relationships, inter-dependencies, sequence in which the works are proposed, should be gone through into as comprehensive a manner as possible. The established techniques such as C.P.M. and PERT can be made use of for working out the overall requirements of the equipment. It is also necessary to establish and complete all infra-structure, workshop and other service facilities before starting the construction work in full swing.

10.13 Variety of equipment available today makes it rather difficult to determine what combinations of machines will give the best results. The analysis of equipment systems can be divided into two parts - the prediction of the performance of the proposed equipment system and the comparision of various combinations to achieve the best combination for the job contemplated. Wherever possible, full analysis of operating systems should be made to provide correction and control factors for the modifications of proposed systems and operating systems.

10.14 It is also necessary that the equipment is purchased in a phased manner, well in advance, so that the machines are available when the work in full swing is actually started. The phasing should be done in such a manner that the machines are not kept idle for long time awaiting starting of construction.

There is need for phased replacement of equipment by inducting new equipment at different stages of Project construction in major projects where the duration of construction is large. It should, however,

be ensured that the new equipment purchased spends about 75% of its economic life on the Project.

Manufacture of equipment indigenously

10.15 Indigenous manufacture of heavy earthmoving equipment was started in India over 20 years back when Director General Ordnance Factories produced the Komatsu D-120 & D-80 Crawler Tractors in collaboration with Japanese manufacturers. Gradually the manufacturing programme of DGOF expanded leading to setting up of M/s. Bharat Earth Movers Limited under the administrative control of Ministry of Defence. The Earth Movers Factory which went into production in 1967 has so far produced nearly 5000 heavy earthmoving equipment. Following heavy earthmoving equipment are manufactured by M/s. B.E.M.L:-

1.	Crawler Tractors	- 90,180 & 250 H.P.
2.	Wheeled Tractors	- 115 H.P.
3.	Rear Dumpers	- 25, 35 & 50 T Capacity
4.	Loaders - Track Type	- 1.3 & 2.3 cu. m.
	Wheeled Type	- upto 3.5 cu. m.
5.	Motorised Scrapers	- 14 cuyd capacity
6.	Motor Graders	- 115 H.P.

BEML also produce 30 T bottom dumpers and 20 T mobile cranes against specific orders. They have plans to manufacture 300 HP and 400 HP Crawler Tractors and rear dumpers upto 80 T Capacity in the near future.

The other major manufacturer of heavy earthmoving equipment in the country is M/s. Hindustan Motors who manufacture following equipment in collaboration with M/s. General Motors Corporation:-

1.	Crawler Dozers	- 275 HP
2.	Dumpers (rear)	- 25 & 35 tonne capacity
3.	Loaders	- 2½ cuyd. capacity.

The excavators are being manufactured indigenously by(i) M/s. Hindustan Motors,(ii) M/s. Tata Engineering & Locomotive Co. Ltd., (iii) M/s. Larsen & Toubro Ltd., and (iv) M/s. Heavy Engineering Corporation.

The towed scrapers are manufactured indigenously by M/s. Hindustan Earthmovers P. Ltd., and loaders by M/s. Escorts Limited.

10.16 With the ever increasing investment in the I&P Sectors and other

sectors like mining, using heavy earthmoving equipment, the emphasis was laid on larger capacity equipment. Presently, most of the equipment required is produced indigenously except some equipment in the higher capacity range viz. dozers, motorised scrapers, truck tractors for 60-100T Trailers, etc., which are imported.

10.17 There is urgent need for improvement in technology of the machines being produced indigenously, in the equipment support by way of adequate after-sales service, and in the spare parts supply with a view to improve the equipment availability and productivity.

10.18 Import Substitution: The Government of India vide Department of Industrial Development Memo No.16/130/IP/79 dated 6.6.79 set up a committee on import substitution under the Chairmanship of Shri S.M. Aggarwal, formerly Secretary, Ministry of Communications, to examine the existing policies for promotion of import substitution, to review the progress made in this regard and for assessing the effect of liberalised industrial licencing, import and export policies on the programme of import substitution.

10.19 Upon request from this Committee, the erstwhile Ministry of Agriculture & Irrigation (Department of Irrigation)under their letter No. 45/85/79-CHK dated 11.9.1979 appointed a Working Group to undertake study of areas concerning the equipment for the irrigation etc., and to prepare a discussion paper thereon for consideration of the main Committee on import substitution.

10.20 As per information collected by this Working Group on import substitution, the total value of equipment imported by Members of the Tractors Earthmoving and Construction Equipment Distributors' Associations Limited in the various sectors including Irrigation Projects since 1948 amounts to about Rs. 1,202 crore. This evaluation of the equipment has been done on the basis of current prices.

10.21 It has been assessed that the main reasons for continuing imports are as under:-

1. Sophisticated technology for manufacture is not available in the country.

2. Quantity required to be manufactured is uneconomical for production even though the appropriate technology could be imported.

3. Indigenous development work has not been completed although the same has been taken up in hand.

4. Reluctance on the part of users to use indigenous equipment

as the after-sale service is not considered upto their satisfaction in some cases.

5. The manufacturers have not carried out detailed market surveys to develop their future manufacturing programmes. There is also considerable communication gap between the manufacturers and users.

10.22 The various constraints in the way of achieving indigenisation in the field of earth moving equipment were discussed by the Working Group with some of the major manufacturers of equipment in the country. They pressed that the prime factor which has been responsible for restricting the indigenous development is economics of scale. The other factors which have been responsible for restricting the indigenous development are as under:-

1. Non-availability of appropriate technology in limited areas like production of sintered friction disks used extensively in power shift transmissions and clutch assemblies.

2. Non-availability of special purpose heavy duty steel castings and forgings.

3. Non-availability of high pressure and high discharge hydraulic system elements.

4. Non-availability of rolled steel sections and special alloy steel casting of thin section required for track shoe section and floating seals of crawler tractors.

5. Non-availability of basic cold drawn seamless steel tubes and packings/seals required for hydraulic cylinders.

6. Non-availability of special/over-sized bearings from the bearing manufacturers in the country who are not willing to take up the manufacturers of these items.

10.23 An effort was also made to identify the areas where indigenisation could not be achieved which in turn is affecting the programme of import substitution. It was revealed the following are the major areas where indigenisation could not be achieved:-

1. Transmission
2. Drive Lines
3. Hydraulic Pumps
4. Heavy Duty Clutches
5. Heavy forgings and castings.
6. Differential bevelgear and bevel pinion

7. Sprockets
8. Special and over sized bearings.
9. High pressure hoses etc.

10.24 It was pointed out by the indigenous manufacturers that it is not possible for them to undertake manufacture of all the high cost items under one roof as quantity involved will not justify indigenous production economically. The manufacture of the high value items like power shift transmission etc. for which M/s. Hindustan Motors and M/s. Bharat Earth Movers Limited have already been licenced, would be taken up shortly. Other items like gaskets, drive lines, high pressure hoses etc. have to be manufactured by other companies/ancillary industries.

Updating Technology and latest Equipment:

10.25 Most of the equipment being produced indigenously is in collaboration with foreign manufacturers. In the developed countries, there is a constant effort in updating technology and metallurgy to improve equipment efficiency and performance. The various developments in technology include lighter engines with higher HP to weight ration achieved through use of lighter metals and alloys, introduction of torque convertor drive, to provide wide range of tractor effort for varying load conditions, metallurgical advances leading to lighter and stronger chassis frames and improved abrasion resistance leading to higher component life, automatic hydraulic/electric operation through push buttons control leading to operator comfort and higher efficiency, use of high pressure hydraulic systems, improved tyres and tubes for better traction and floatation, improved POIs, and fuel and lubricating systems. All these improvement have led to higher efficiency and lower cost of operation. However, in our country, there is hardly any effort in this direction. There have hardly been any improvement over the past 2 decades.

10.26 There is dire need for updating technology in order to achieve higher efficiency, availability, ease of operation and lower initial cost as well as total operating and owning costs. There should be a constant feed back from the users of equipment to enable the manufacturers in improving their products.

10.27 A sense of competition is essential to imbibe cost and quality consciousness in the manufacturers of equipment. It will be worthwhile to import selected equipment with latest technology from time to time so that we may be able to compare the performance of indigenous equipment with those produced in the developed countries.

Infrastructural Facilities, Individual Vocational Training:

10.28 In order to achieve better performance and lower owning and operating cost of equipment, it is essential to set up the infrastructural

facilities before undertaking any major construction project. These facilities basically include the following:-

1) Central Workshops
2) Field Repair Shops.
3) POL Storage & Dispensing Facilities.
4) Spare Parts & Misc. Stores.
5) Stores Procurement & Inventory Control Unit.
6) Training of Operators & Mechanics.
7) Residential, Educational, Medical and other social needs for workers.

1) Central Workshop: Central Workshop should be planned, keeping in view the fleet of equipment to be used and should cater to the various functions necessary for efficient repairs and maintenance service. Basically, the Central Workshop should have the following sections:-

(a) Machine Shop:

This should have the basic machine tools e.g. Lathe, shaper, Milling Machine, drilling machine,bench grinder, Hydraulic Press, etc. In addition the special machines e.g. Crankshaft grinder, line boring machine, cylinder boring & honing machine should also be provided.

(b) Foundry & Smithy Shop:

It should be a small unit capable of manufacturing small items in ferrous & non-ferrous metals.

(c) Heavy Equipment Repair:

This can be further sub-divided as per the various categories of equipment under operation. Sufficient tools, general as well as special should be provided and the mechanics should use the right tool for right job with particular emphasis on proper engine reconditioning.

(d) Automobile Repair Shop:

This should cater to the requirement of inspection vehicles & trucks, etc. Sufficient general & special tools should be provided.

(e) Fabrication Shop:

Depending upon the job requirements of a particular

Project, fabrication shop should have facilities for cutting, bending, drilling welding of sheets, plates, pipes and other structural steel sections. In case the shop is required to manufacture critical items e.g. penstocks, gates etc. facilities for sand blasting, continuous/automatic welding and cutting, hydraulic and ultrasonic testing etc. should also be provided.

(f) Electrical Repair Shop:

This should have the facilities for repair of electrical components of the machine e.g. alternator/dynamo, self-starter, batteries & other components of the electrical systems. This shop should be provided with sufficient tools & test kits.

(g) Radiator Repair Shop:

Radiator repair/maintenance is very essential for efficient cooling system.

(h) Fuel Pump & Nozzle Repair shop.

2) Field Repair Shops: These should be provided at the main work sites to cater to the needs of on-the-spot minor repairs of equipment.

3) POL Storage & Dispensing: There should be adequate storage of P.O.L depending upon the lead time of procurement. All grades of P.O.Ls. as per recommendation of the equipment suppliers should be available. There should be proper storage to avoid contamination and wastage. Proper Petrol/Diesel dispensing pumps & lubrication units should be provided.

4) Spare Parts & Misc. Stores: In order to achieve higher operating efficiency and availability of equipment, it is essential to store adequate quantity of spare parts and other miscellaneous stores used in repair & maintenance of equipment. The spare parts should be properly codified and proper record of the consumption should be kept to enable proper planning and procurement.

5) Stores Procurement & Inventory Control: Efficient stores procurement & inventory control organisation is very essential for efficient utilisation of equipment. The requirement of spare parts and misc. stores should be planned judiciously. This subject has been discussed in detail under Term of Reference III.

6) Training of Operator & Mechanic: There is a dearth of trained personnel in the country It is essential to have a prop-

arrangement of programme to train the operators and mechanics on specific machine to obtain the desired level of utilisation of equipment. Whereas some training can be given on the job, the formal training in specialised institutions and at manufacturer works will go a long way in improving the equipment utilisation.

Training camps should be set up at each major Project for which necessary provision may be made in the Project report and annual Plan outlay.

7) Residential, Educational, Medical & Other Social needs for Workers:

Unless the workers are free from the worries of the basic social requirements, efficient working of equipment cannot be ensured. Workers should be provided with these facilities before they start agitating for them.

Safety:

10.29 An accident-prevention programme should be set up in order to reduce the cost of construction measured in terms of:

i) Human lives sacrificed.

ii) Temporary and permanent injuries to workmen.

iii) Damage to equipment and loss of materials.

iv) Loss of time because of accidents viz. man-hours and machine-hours lost.

Success of a good safety programme depends upon planning, physical set-up and co-operation of all personnel.

10.30 Accident prevention on construction jobs is mostly a matter of education, vigilance and co-operation. Hard and fast rules alone will not ensure safety on the job. This can be secured only by constant and careful attention on part of the site Engineer and construction Foreman, with co-operation of the workmen. Men should be taught to think in terms of safety and taught not to take unnecessary chances.

10.31 An accident is an unintentional interruption to an orderly process, a turning aside of an intended procedure. The injury to persons is only the evidence of an accident, the outward sign of something gone wrong. To prevent accidents, it is necessary to go back to the cause or causes leading upto the occurrence. If accidents occur with no injury to persons, they still should be listed and investigated with a view to avoid them.

Some sensible rules for safety of personnel are:-

i. Good house keeping is the first law of accident prevention on construction jobs. Confusion will be reduced and operations will be more efficient when the work area is neat and orderly at all times. Rubbish, debris, waste and useless material constitute fire and accident hazards on the job and should be removed from the work area as fast as they accumulate. Special receptacles, with selfclosing lids, should be provided for combustible materials such as oily or gunny rags, waste etc. and such materials should be burnt as soon as possible.

All boards, planks, blocks, debris and other materials having projecting nails should be placed in orderly piles where workmen will not be likely to stumble or fall on them.

All passages, stairways, corridors, ladders etc. should be kept clear of loose material and trash.

ii. Provision of fire extinguishers and first aid kits should be made necessarily in the workshop and at work sites.

iii. Smoking (when and where).

iv. Properly support a piece of equipment.

v. Always use goggles or safety glasses when grinding or welding.

vi. Proper use of cleaning fluids; do not use inflammable fluids for cleaning of equipments.

vii. Keep hand tools in good working condition. Do not use poor tools.

viii. Keep equipment clean and in good condition and check it frequently.

ix. Follow correct procedure of equipment operation and maintenance.

It should help matters to assign a Safety Supervisor for workshop and each work site.

PERFORMANCE OF CONSTRUCTION EQUIPMENT:

10.32 Although construction plant and heavy earthmoving equipment have been in use for construction of Multi-Purpose Hydro Electric Projects

and Irrigation Projects in the country during the last about 35 years, comparative studies of performance of various categories and makes of equipment have not been made. This has resulted in each project Construction Engineer adopting his own performance schedules and production norms. Detailed time and motion studies were not conducted on any Project to determine the causes for avoidable delays and factors due to which optimum outputs were not achieved. These studies should be periodically conducted on projects to determine the causes for avoidable delays & factors due to which optimum outputs are not achieved. There is no uniform standard which can be used as a guide in classifying a job. Each job planner has to use his own Judgement and experience in deciding which condition best represent his Jobs - The data so collected should be analysed so that factors for Job and Management factors can be easily determined.

10.33 With a view to determine causes for low earthwork production with the excavation equipment and excessive cycle time with the haulage equipment, time and motion studies were carried out at the following Projects:-

i. Anandpur Sahib Hydel Project (Pubjab)
ii. Salal Hydro Electric Project (J&K)
iii. Lower Manair Dam (A.P.)
iv. Chakra Project (Karnataka)
v. Mahi Bajajsagar Project (Rajasthan)
vi. Daman Ganga Project (Gujarat).

10.34 The observations made during time and motion studies have brought out following information:-

(i) For the excavation of Hydel Channel at Anandpur Sahib Hydel Project the hourly production observed with 1.91 cu.m. indigenous dragline for sidecasting of hard strata with boulders was 129.6 cu.m/ hour and for silty clay 150.9 cu.m/hour. The hourly productions observed with 2.3 cu.m. indigenous shovel were 168.1 cu.m/hour, 231.6 cu.m/hour and 427.6 cu.m/hour at 3 different sites for excavation in silty clay in the same hydel channel with the same make of shovel. Two indigenously manufactured dumpers of 25 ton capacity were used for transport of the materials for these three shovel observations. The corresponding hourly production of the dumpers are as under:-

Shovel	Lead	Dumper	Type of Material
168.1 M^3	196 M	89.94/111.25M^3	Silty clay
231.6 M^3	234 M	93.40 M^3	-do-
427.6 M^3	323 M	120.6/155.3 M^3	-do-

The variations in the hourly production on this project are due to (i) operators' skills and experiences. (ii) depths of cut, and (iii) angles

of swing. It was arranged that there was no idle time for the shovel for which purpose sufficient numbers of dumpers were provided which resulted into some idle time for the dumpers.

. On the same Project a 4.6 cum Electricl Shovel (indigenous) gave an output of 363.7 cum/hr. 25 T (indigenous) dumper with this shovel gave an output of 98 cu.m./hour over a lead of 285 M.

(ii) In Salal Hydroelectric Project, the 4.6 cu.m. Electric Shovel (indigenous) gave a production of 205.78 cu.m./hour (clay) in combination with 50 T Rear Dumper (indigenous) whose hourly production was recorded as 74.87 cu.m. over a lead of 680 M. In this Project 1.91 cu.m. shovel recorded hourly production of 196.33 cu.m./hour and 114.17 cu.m./hour in two different studies. For these two studies, the hourly production of 35 T rear dumpers (indigenous) and 35 T bottom dumpers (imported were 64.09 cu.m./hour and 28.6 cu.m./hour respectively over a lead of 540 M.

The differences in output of similar items of equipment at same site or same items of equipment in different studies are due to the operators' skill and efficiency, condition of the machines (old/new) and the variable idle time observed between various activities of operation. The low output of 4.6 cu.m. shovel was due to the wet clay sticking in the shovel bucket thereby reducing the effective capacity of the shovel bucket. For the 50 Ton dumpers the production was low due to spillage of clay through holes in the dumper bucket (which are meant for slinging during transit and should be plugged during operation) and from the rear end while climbing gradients which could be avoided by providing side boards.

(iii) In Mahi Bajaj Sagar Project the 1.91 cu.m. indigenous shovel recorded an hourly production of 187.9 cum/hr. for semi-pervious material whereas a hydraulic excavator of 0.9 cu.m. capacity recorded only 47.02 cu.m./hour. For other equipment the production was recorded as under:-

Equipment	Average cycle time	Type of Material	Production per hour	Remarks
285 HP Dozer (Imp)	1 Mt. 23 sec.	-	192 cu. m	Dozing distance 64 M
165 HP Dozer (Und)	Not recorded	earth	296 cu. m	-do- 145 M
410 HP (Imp) Dozer	1 Mt. 27 sec.	S.P.	Not recorded	-do- 30 M
410 HP Ripper (Imp)	1 Mt. 16 sec.	S.P.	1187 cu.m	Dozing distance 30 M

Vibratory Compactor (Ind) 107 HP	1 Mt. 29 Sec.	S.P.	68.56 cu.m.	99.73% compaction achieved after 24 passes
3.44 cu.m. loader (Imp)	39.5 sec.	S.P.	235.19 cu.m.	-
1.91 cu.m. Dozer Shovel (Ind)	41 Sec.	S.P.	92.29 cu.m.	-
15 T Dumper (Ind)	7 Mts. 29.3 Sec.	S.P.	34.30 cu.m.	Lead 745 M

(iv) In Chakra Project (Karnataka), the hourly production of a 3.2 cum. indigenous Hydraulic Shovel was recorded as 138.25 cu.m/hour in hard rock boulders. The hourly production of two makes of indigenous 25 T dumpers with the above excavator were 33.66 cu.m./hour and 37.27 cu.m./hour respectively on a lead of 2 km. whereas hydraulic excavator of 0.866 cu.m. capacity recorded a production of 99.213 cu.m./hour in Murram. Indigenous Tippers of 4·5 cu.m. capacity in combination with this excavator gave an output of 36.39 cu.m./hour over a lead of 295 Mts. In the same Project, an indigenous Dozer 250 HP recorded a production of 189.54 cu.m./hour in Murram. A 11/16 cu.m. indigenous scraper gave an output of 92.208 cum/hour of Murram over a lead of 1.1 Km, the pusher (250 HP Dozer) cycle time being 1 Mt. 25 sec.

(v) In Lower Manair Dam Project (AP) the study was conducted on scrapers/pushers and following results were obtained.

Scraper	Pusher	Lead	Material	Average cycle time	Hourly Production (50 Mts)
15.3/116.8 cu.m.	280 HP (Imp)	3.2 Km	B.C. Soil	20 M 54 sec.	44.18 cu.m.
10.7/13.7 cu.m.	-do-	2.5 Km	Casing soil	14 M 27 Sec.	54.93 cu.m.
10.7/15.3 cu.m.	-do-	3.0 Km.	B.C. Soil	21 M 07 Sec.	33.08 cu.m.
8.4/12.2 cu.m.	-do-	3.0 Km.	Casing soil	19 M 20 Sec.	37.32 cu.m.

A 280 HP imported dozer/pusher gave a production of 337.06 cu.m. /hour over a lead of 56 M in BC Soil and a production of 414.63 cu.m./hr.

in casing soil over a lead of 55.02 M.

(vi) At Damanganga Project (Gujarat) two indigenous makes of 1.9 cu. m. Shovels recorded output of 260.9, 288.8, 239.3, 242, 271 and 231.91 cu.m. per hour respectively in 6 different studies. The corresponding hourly productions of Dumpers were as under:-

Dumper size	Lead	Hourly Production
9.5 cu.m.	1.314 Km.	52.18 cu.m.
17.82 cu.m.	1.314 Km.	96.3 cu.m
12.3 cu.m.	1.314 Km.	59.8 cu.m
17.82 cu.m.	1.6 Km.	80.6 cu.m.
12.3 cu.m.	1.6 Km.	67.75 cu.m.
9.5 cu.m.	1.6 Km.	46.40 cu.m.

An indigenous Track Shovel Loader 2.3 cu.m. capacity recorded an output of 156.15 cu.m./hour, in combination with 4 Nos. 9.5 cu.m. dumper over a lead of 1.24 Km. in base material. Same track loader recorded an output of 72 cu.m. per hour in well blasted rock in combination with 2 dumpers of 12.3 cu.m. capacity over a lead of 1.332 Km. An imported track loader of 1.9 cu.m. capacity recorded an output of 146.8 cu.m/hour in base material (sand and gravel) in combination with 3 nos. 9.5 cu.m. dumpers over a lead of 1.24 kms.

A Dozer Ripper of 410 HP recorded a combined ripping and dozing of 363 cu.m. and 502 cum/hr. in two different studies in semi pervious soil. A 300 H.P. ripper recorded a combined ripping and dozing output of 173 cum/hr. in the same soil.

A 16/23 cu.m. scraper recorded an hourly production of 445.76 cu.m. over a lead of 1.169 Km. The scraper was push loaded by a 410 HP Dozer with a cycle time of 101 seconds. The maximum quantity of pervious material loaded in the scraper was 20.375 cu.m.

For compaction of Semi pervious material a 60 Tonne tyred compactor recorded an output of 140 cu.m. (compacted) per hour and a single drum sheep foot roller recorded output of 77 cu.m./hour.

Average cycle time for excavators observed during time and motion studies:-

Project	Excavator size	Average cycle time observed (seconds)	Standard Norm (seconds)
Anandpur Sahib	4.6 cu.m. shovel electric (ind)	37.3	24
Salal Hydel Project	-do-	37.69	24
Anandpur Sahib	2.3 cu.m. O (ind)	30.50	22
-do-	-do-	30.41	22
-do-	-do-	19.80	22
-do-	1.91 cu.m. dragline (Ind)	51.00	37
-do-	-do-	36.49	30
Mahi Bajajsagar	-do- shovel	25.9	21
Salal Project	-do-	27.86	21
-do-	-do-	29.1	21
Mahi Bajajsagar	0.9 cu.m. hydraulic shovel (imp)	28.00	
Chakra Project	-do- Back hoe (imp)	155.00	
-do-	3.2 cu.m. hydraulic shovel (ind)	22.30	
Daman Ganga Project	1.9 cu.m. shovel (Ind)	24.7	21
-do-	-do-	21.5	21
-do-	-do-	21.2	21
-do-	-do-	25.0	21
-do-	-do-	25.0	21
-do-	-do-	27.35	21

10.35 Norms of production: Cable Excavators (shovels/draglines): The

figures of hourly output (loose), angle of swing and depth of cut as obtained during time and motion studies at different projects have been tabulated at Annexure XIV. These have been compared with expected productions, taking into account, ideal hourly outputs as per PCSA (Power Crane and Shovel Association) factor for depth of cut and angle of swing and factor for job & management (assumed good) and swell factor. The last column gives the ratio of actual hourly production as observed and the expected production worked out as above. Average of these ratios for all the studies works out to 93.66%.

Thus for the purpose of production norms for excavators the figures of P.C.S.A. (together with various standard factors) can be adopted with an additional factor of 90% to suit the conditions prevalent in this country.

For "Job and Management factors" constants as specified in the report of the Committee on "Formulating Guide Lines for preparation of feasibility of detailed project report of Irrigation and Flood Control Projects" can be adopted.

10.36 Suggestions for improving output with Machinery:

(1) Organisation:

To meet with the requirement of optimum utilisation of available resources specially to fulfil the scheduled targets, to start with, it is the first requisite to establish an organisational nuclii of experienced and competent engineers on each major project who would administer management and construction activity with energy and wisdom, and locate opportunities for improvement of factors effecting economical productipn by construction equipment and manpower. The construction management involves planning programming and controlling of construction progress of various components of the project with a view to determine the Project component, construction duration, more accurately and co-ordinate these activities so that the different stages of project construction are given the required attention at pre-determined time intervals. The 'time-aspect' of the development project is concerned with speedy completion of the project so that the end benefits are realised at the earliest. Alongwith this the 'cost-aspect' is equally important with a view to economical construction.

First requirement towards achievement of the objective is to establish a well-defined organisation indicating the persons, positions, authority, contacts, operations and coordination. For this purpose all the activities expected to be performed for execution of the job are listed, grouped according to inter-activity, sorted to suit the operation sequences, and arranged in the system of administrative authority with adequate provision for coordination. The upward movement of infor-

mation and downward movement of instructions should be fast and smooth so that the organisation should function intelligently.

Proper organisational planning requires evaluating the capabilities and defining the functions of each individual or group of individuals. There must be adequate scope to train and develop the new entrants to the organisation.

Organisational planning should eliminate duplication of work and efforts and reduce confusion of operations, decreasing friction among individuals. It must ensure effective coordination and direction of human effort in performance of the assigned functions. Each individual must be aware of his accountability for performance of assigned duties.

Delegation of powers and workload to the local engineers in itself does not ensure success of project. Each engineer must not only be competent and able but must also integrate and coordinate his work with others on the project. Only those willing to cooperate will contribute to the work to accomplish the proposed objective and enjoy certain personal satisfaction in the accomplishment.

Posting of observant and understanding engineers who can team up the conflicting manpower would develop valuable assets whereas the same manpower, unguided or uncurbed, can wreck or at least slow down the project. Such teaming requires careful thought and execution and thorough understanding of personalities involved. Individuals of limited capacities should not be placed in responsible positions because their deficiencies will adversely affect the entire organisation. Careful evaluation of each individual's potentials would bring out misfits.

(2) Accessibility of the Project Site:

This imposes limitations. Therefore, it is necessary to clear the project area of trees, stumps and boulders etc., to build proper roads, housing and service facilities for the men and rail transportation for the materials. Proper roads to and through the job are required to be constructed alongwith other facilities. For transportation of construction materials haul roads of proper grades are to be constructed.

(3) Climatic conditions:

The number of working days and weather conditions are to be correctly forecast for construction planning. Excessive rain fall will not permit work to be continued. It would become important to complete certain portions of work before start of rainy season or before rise in river water level. The number of machines and working shifts depends directly upon the estimated number of working days during the season. A

realistic daily production quota is fixed and proper machines are put on the job to handle it.

(4) Operating Efficiency:

Experience on projects has shown that it is difficult to work consistently at a higher productive efficiency than 50 min. hour (83%). This is subject to staff being provided with suitable housing facilities and services, a living wage, food at reasonable rates and transportation. No workman is required to walk on foot or cycle a few miles on rough roads to reach workspot and then to hunt for drinking water there.

Scientifically trained and experienced men are by far the greatest asset to operating efficiency and consequently the production ability of the equipment.

Technical Institutes may be established to train operators and mechanics on earthmoving equipment including diesel engines. Following courses are suggested:-

i. Operation and maintenance of trucks, scrapers, dozers and loaders - 200 hrs.

ii. Operation and maintenance of motor graders and compactors - 200 Hrs.

iii. Operation and maintenance of backhoe, clamshell, shovel, and dragline - 400 hrs.

iv. Mechanics course - 540 hrs.

The trainees should be at liberty to take any or a combination of these courses. The training method should be based upon the principle to make every trainee conversant with the basic technical points involved and the necessity and reason for each component of the equipment. Class room lectures, illustrations, tearing down the equipment to basic units and study, reassembly of the units, are aids to make the student familiar with the equipment.

It will be possible for the Training Institutes to produce good technicians with the extensive and intensive training. 40 hours of actual operating time on any machine is the minimum requirement. For specialization of an advanced degree the requirement is upto 100 hrs. per machine.

(5) Efficient management of borrow area and fill:

Carefully trained and conscientious supervisory staff can (i)

prevent damage to equipment (ii) increase operator confidence (iii) reduce equipment waiting time (iv) increase actual production and (v) make significant contribution towards lowering production costs and attaining scheduled production.

(6) Tyres:

Selecting the right tyre, size & type is the primary step for rubber tyred earthmoving equipment. The best tyre for a particular job is usually a compromise and some of the factors which enter into choice are load, type of equipment, type of body, material of haul road, haul distance and grades, speeds in view, climatic conditions and variations, and materials to be hauled. Too much internal heat at high speeds is to be avoided. The tyre companies usually provide competent engineers to consult on the problems on particular jobs. The damage done to the tyres by overloading and over spreading is ruinous. Apart from the loss due to cost of tyres, the loss due to down time of the equipment will be considerable. Stones and rocks in the borrow pits and haul roads are to be removed so as to eliminate the chances for shock damage.

(7) Haul roads:

Properly maintained and levelled haul roads contribute towards reducing the rolling and grade resistance and thus in attaining better traction and haul speeds. It may be advantageous to reduce the grades by suitable alignment of the haul road. With this the distance of haul road may increase but the time involved in round trip may be reduced. For maintaining better speeds it would be advantageous to avoid short turning points at the haul road.

(8) Spare parts:

Improvement in parts availability will definitely contribute effectively towards increase in the utilization rate of construction equipment. The projects have not established proper ordering and stocking procedures for spare parts. The procedures involved are rather cumbersome and are designed more for satisfaction of audit than for efficient management. This subject has been discussed in detail under Chapter VII.

10.37 Conclusion and Recommendations:

1) Construction Engineers held an important position in the industry and play effective role in development of nation's economy and society's betterment. Government of India must take into recognition this basic fact, evaluate the same accurately and create a balanced system of construction administration vis-a-vis other All India Services. The era of trials and tribulations of haphazard experimentations with manpower must be brought to an end on priority basis.

Machinery and equipment are worth the price of steel by waight till these are used as production tools by construction engineers. Apart from proper selection of equipment and its maintenance and operation, reasonable facilities be created and provided for construction engineers.

2) A healthy personnel policy be evolved and followed. It must be borne in mind that the employer and the worker have a common and sympathetic interest in the industry and both benefit by harmonious relationship and continuous peace. The capacity and willingness to work should be the sole criteria for job assignments to the workers.

3) Complete stress be laid on full cooperation and coordination amongst the Mechanical Engineers and supervisory staff on the job.

4) Classification and pay scales for operating and maintenance personnel for construction equipment on uniform basis should be considered. It would be necessary for their proper deployment that a central employment bureau be established for these personnel.

"There has been no attempt to standardize wage structure of Operators & Mechanics of heavy equipment. There is very wide diversity in wage structure of Government of India Undertaking and private Contracters and State Governments. Though there may be some justification for differential wage structure between the private sector projects and Government; there seems little justification for keeping wide disparities in the wage structure for these categories from State to State and Centre. This may result in sub-standard working, operation learning, making of mistakes and abuse of equipment besides inadequacy of service. It is necessary that this is looked into at the appropriate Administrative level.

5) Safety measures be adopted with complete devotion. Safety devices like hard hats, safety belts, goggles, long boots and gloves are used. Safety posters are displayed prominently. A safety engineer should be busy teaching safety measures and checking their observance.

6) The technique of job analysis and plant application has been developed on scientific lines and the same technique can be applied to all projects in India.

7) Complete emphasis should be laid on the fundamental need to procure the required equipment production hours rather than the piece of equipment.

8) Organisation of training centres at major project sites with facilities to impart all basic knowledge about the operation and maintenance of the equipment is recommended. The training imparted to the technicians through short term training courses will have a marked improvement on operating life of the equipment.

9) certain information like improvement kits, assembly drawings and service bulletins are being periodically issued by the manufacturers and will be of great advantage for reference for projects in India.

10) The repair shops should be equipped with suitable hoist tools, portable steam cleaning plant, and compressed air line with out-lets.

11) The repairs and overhauls of prime movers, fuel pumps, transmissions, tracks etc., should be done in special shops equipped with special tools and testing devices. A few prime movers and transmissions should be kept spare to assure uninterrupted execution of work.

12) Preventive maintenance should be carried out when due; fuels and lubricating oils are stored in large size tanks on tressels from where these are taken out through taps and pipe lines.

13) The engine crank case oil should be analysed periodically in the laboratory of suppliers of lubricating oils. The test reports show oil viscocity, detergency activity, water emulsion, fuel dillusion, fuel sooth, sludge index, presence of metal, carbon, dirt, sand etc., in the oil. Such facilities are available with the oil companies in India.

14) Equipment Dealers should maintain field warehouses at site of work so that spare parts can be readily supplied as and when needed. Also they should arrange component exchange facilities from these warehouses.

15) Liberal training in India and abroad is necessary for orienting project officers in the production method and equipment management. Though there have been early programmes under the TCM and Colombo Plan. Very few officers have been deputed for the same. There, therefore, is a vacuum & complacency inspite of poor production standard. At least in import contract provision of foreign training for junior executive from the State must be a provision. This system was adopted in M.P. to some benefit.

16) Last but not the least proper haul roads be constructed and maintained with graders and water tankers.

XI. SUMMARY OF RECOMMENDATIONS

CHAPTER XI

RECOMMENDATIONS OF THE COMMITTEE:

LABOUR UTILIZATION ON RIVER VALLEY PROJECTS:

1) Flexible approach be adopted to mechanisation as well as labour intensive technology on irrigation projects keeping in view the rate structure of the items. (Para - 2.59)

2) The earth dams of small magnitude involving 1.5 M. cum of earthwork or 30 metres height or masonry dams of 30-40 metres height be planned as labour intensive works. (Para - 2.61)

3) Advance planning for capital intensive major project which are multipurpose should be done at project approval stage after accounting for work possible to be done by labour intensive methods. (Para - 2.62)

4) Some unified labour recruitment methods and labour laws are desirable. (Para - 2.65)

5) The provisions of the local laws in regards labour welfare be strictly enforced. Adequate housing, water supply, transport facilities, Schooling facilities, medical facilities, Cooperative shop to supply subsidised rations be ensured and suitable steps for check on spread of epidemics taken. There should be Welfare Officers on the project appointed to look after the welfare of the workers. (Para - 2.66)

6) Perspective planning should be made for continuous employment of labour from one project on completion to other projects. For slack seasons (non-working Season) alternative works should be reserved for providing seasonal employment. (Para - 2.66)

7) Suitable training programme should be organized to raise standard of productivity. (Para - 2.66)

8) Some expenditure shall be earmarked in large projects for training labour in high productive technique and introduction of high production tools. (Para - 2.66 'K')

9) A system of registration and circulation within the state of skilled workers likely to be made surplus on completion of projects be introduced. List of such workers, to be made surplus on completion of project be circulated to other projects within the State and other projects in the country. (Para - 2.67)

STANDARD DESCRIPTION OF MAIN ITEMS OF UNIVERSAL NATURE IN RATIONALISED UNITS:

10) Items in the contract should be correctly defined to avoid controversy with contracting agency. (Para 3.02)

11) Standard description of Main items of Universal Nature and the units of measurement as detailed out be adopted on all River Valley Development works. (Para - 3.02)

STANDARD SPECIFICATIONS:

12) I.S.I have so far published 200 Standard specifically pertaining to various aspects of design construction etc., of River Valley Projects. Wherever Indian Standard Code of practices are available, which give detailed specification of workmanship, they should be incorporated in the Contract specifications to the extent they are applicable to the item of work. (Para - 4.07)

13) While drafting the contract specification only reference to relevant Indian Standards in respect of quality of input and method of testing the input and sampling be given instead of repeating the same. (Para - 4.08)

14) For large number of items connected with River Valley Projects, a standard pattern of Uniform Contract Specification can be drawn up to remove the present inconsistency which many a times occur while drafting Job specifications for each Job. (Para - 4.09)

15) Great care and importance has to be given to formulating of specifications, taking into account the various conditions under which works have to be executed. (Para - 4.10)

16) In the River Valley Projects on many occasions as in case of small works, like cross drainage works or other structures on Canals, branches and distributaries, have items of work of repetitive nature without much variations in the specifications. Standardization of specification for such repetitive items is required. (Para - 4.28)

17) Synthesis of the standard specifications framed by several States and Departments be undertaken by a specialised cell as a whole time job. (Para - 4.29)

STANDARD METHODS OR MEASUREMENT:

18) The method of measurement should be as per Indian Standards. (Para - 5.02)

19) To make the contract unambiguous it would be proper to provide method of measurements along with specification for each of the item of work for which a separate rate is stipulated in the contract. (Para - 5.03)

ANALYSIS OF RATES - BOTH FOR MANUAL AS WELL AS MACHINERY WORKS:

20) For fixing the hourly use rate of Machines and Equipments the evaluation of various elements of ownership and operation cost should be done as detailed out. (Para - 6.03)

21) Format for working out hourly use rate of various machines and equipments deployed in River Valley Project Construction as given in Volume II be followed. (Para - 6.05)

22) Judicious provision of hidden cost of labour has to be made over and above the basic wage of the labour depending on statutory provisions, applicable and practices prevalent for benefits and amenities to workers in the project. In the format of analysis this hidden cost has been adopted as 50% of the direct cost of labour. (Para - 6.15)

23) It is difficult to identify overheads and profits precisely a provision at 20% of prime cost as made in the analysis of rates is recommended. (Para - 6.18)

24) Format of Analysis of items of Universal Nature as indicated in para 3.09 and as dealt in Volume II is recommended. (Para - 6.18)

25) Where Standard or Schedule of rates are revised or where is necessity to do so, the primary guiding principle should be escalation in Labour and Material cost and not the trend of rates quoted by contractors. (Para - 6.18)

MATERIAL MANAGEMENT & INVENTORY CONTROL:

26) Inventory Control Cells be created at all major projects costing over Rs.50 crores essentially to be executed departmentally and under the C.M.U's in each State. It has to be ensured that all functions of Material management come under unified direction and answering for efficient working. (Para - 7.08)

27) The functions of purchase organisation should be subjected to system Audit by a cell established for the purpose. (Para - 7.08)

28) There should be a small Commercial Intelligence Cell in each State to feed the purchase organisations of the various projects

with Commercial Information and the cell should collect information at intervals, from projects within the State and from Similar Cells in other States about source of procurement and prices paid for the materials purchased for the project.
(Para - 7.08 c)

29) All purchases, routine or emergent, to be made by Central Purchase Organisation should be entrusted to Tender Committees or Purchase Committees. (Para - 7.08 d)

30) Project Engineers be imparted training in Modern system and techniques of Material Management and Inventory Control.
(Para - 7.55)

31) The Materials and spare parts at the Project be classified and coded in terms of their different uses.
(Para 7.55)

32) For proper inventory control, A.B.C. analysis be carried out for seperating the significant few from the relatively unimportant many.
(Para - 7.55)

33) For procurement of stores & quick payment of suppliers bills proper procedures be laid down to reduce the lead time and other delays.
(Para - 7.55)

34) Sufficient attention be given to efficient planning and carrying out the stores keeping functions to minimise the inventory carrying cost.
(Para - 7.55)

35) Immediate action be taken to dispose of the obsolete parts and scrap to reduce the inventory holding cost.
(Para - 7.55)

36) Sufficient care and thought be given for procuring insurance items.
(Para - 7.55)

37) Safety stock and Re-order levels should be decided with care based on past experience to facilitate timely replenishment.
(Para - 7.55)

38) Special cells in the Major projects should devise procedures for timely scheduling of surplus spares and make a concerted effort to collect lists of requirements from Projects using similar equipment and rehabilitate the spares to the maximum possible extent and even pursue the manufacturers/suppliers to dispose of surplus spares if no Government Project need them.
(Para - 7.55)

39) Disposal Committees may be formed in the project/States for disposal of obsolete equipment beyond economical repairs, accidented machines and spares of obsolete equipment rather than their rehabilitating. (Para - 7.55)

40) The Direct demanding officers at various levels should exercise their normal powers in case of purchases of spares parts by the Projects from other projects. (Para - 7.55)

41) The Engineer in charge should have full powers to release equipments/spares to another Project with in the State and the Chief Engineer in charge should have full powers to release such equipment/spares to a project outside the State. (Para - 7.55)

42) Non finalisation of the transfer price should not hold up transfer of equipment and spare parts from project/State to another project/State. (Para - 7.55)

43) Data on stores available and spares required by various projects should be periodically exchanged particularly before overhauling season, this will assist in not only in early acquisition of spares required but also expeditious rehabilitation of surplus spares. (Para - 7.55)

44) Computerisation be resorted to only at Major Projects and State level in C.M.U's for processing of voluminous and complex data for making available prompt and accurate reports. (Para - 7.55)

PERFORMANCE BUDGETING:

45) The problems associated with project implementation and the operation and maintenance of completed project should be anticipated and appraised during Planning stage - Detailed consideration be given to factors which will affect the programme. (Para - 8.04)

46) The presentation of Performance Budget should be on the basis of Annual figures divided into monthly or at least quarterly data on physical output and required physical and financial input. (Para - 8.06)

47) Project will have to devise its own forms for drafting and presentation of its performance budget. (Para - 8.07)

48) A watchful eye, a critical analysis sustained pursuit and capacity to distinguish the consequentials from the non-consequen-

tials should be the key note of the administration of a performance budgeting. (Para - 8.11)

49) Monthly review of performance be undertaken at the level of construction circle and quarterly review at the level of Chief Engineer/Chief Executive of a project & if performance budgeting is to be successful there should be active involvement of all agencies concerned. (Para - 8.14)

GENERAL GUIDELINES ON THE STRUCTURE AND FUNCTIONS OF COST ACCOUNTING CELLS:

50) There should be an appex cell in each State dealing with Co-ordination of the activities of costing in individual projects in the State. It is essential to have independent "Cost Accounting Cell" with each project and a cell with each sub-project if the exigencies of work demand. (Para - 9.15)

51) The cells should be staffed with adequate number of qualified Cost Accountings, Engineers & Processionals. The expenditure on Accounting Cells be limited to 1% of the works outlay. (Para-9.16 to 9.19)

52) Functions of the Cost Control Cell as identified at present. (Para - 9.20)

53) Introducing the system of codification of the works and various items of expenditure and receipts. (Para - 9.22)

54) On job training need be provided to all incumbent of the Cost Accounting Cells in cost accounting, Net work analysis C.P.M. and PERT and performance budgeting. (Para - 9.48)

PERFORMANCE AND OUTPUT OF INDIGENOUSLY MANUFACTURED/IMPORTED EARTHMOVING MACHINERY:

55) Detailed time motion studies should be periodically conducted on projects to determine the causes for avoidable delays & factors due to which optimum outputs are not achieved. There is no uniform standard which can be used as a guide in classifying a job. Each job planner has to use his own judgement and experience in deciding which condition best represent his jobs - The data so collected should be analysed so that factors for Job & Management factors can be easily determined. (Para - 10.32)

56) For the purpose of production norms of the excavators the figures of P.C.S.A. (together with various standard factors can be adopted with an additional factor of 90% to suit the conditions prevalent in the country (Para - 10.35)

57) Balanced system of construction Administration vis-a-vis other All India Services must be created. (Para 10.37)

58) A healthy personnel policy be evolved; capacity and willingness to work should be the sole criteria for Job assignments to the workers. (Para - 10.37)

59) Classification and pay scale for operation and maintenance personnel for construction equipment on uniform basis should be considered at the appropriate Administrative level. (Para - 10.37)

60) Safety measures be adopted with complete devotion. (Para - 10.37)

61) The Technique of Job Analysis and plant application has been developed on scientific lines and be applied on all projects in India. (Para - 10.37)

62) Complete emphasis should be laid on the fundamental need to procure the required equipment production hour rather than the piece of equipment. (Para - 10.37)

63) Organisation of training centres at Major projects sites with facilities to impart all basic knowledge about the operation and maintenance of the equipment. (Para - 10.37)

64) Repair shops should be equipped with suitable hoists tools, portable steam cleaning plant etc. (Para - 10.37)

65) The repairs and overhauls of prime mover, fuel pumps transmissions trucks etc., be entrusted to well equipped special workshops. (Para - 10.37)

66) Preventive maintenance should be carried out when due. (Para - 10.37)

67) Periodic analysis of Engine Crank case oil should be carried out in the laboratory of suppliers, or lubricant oils. (Para - 10.37)

68) Equipment dealers should be directed to maintain field warehouses at the site of work. They should also arrange component exchange facilities from these warehouses. (Para - 10.37)

69) Liberal training in India and Abroad is necessary for orienting project officers in the production method and equipment management. In import contract provision for foreign training for the

Junior executive from the State must be made.
(Para - 10.37)

70) Last but not the least proper haul roads be constructed and maintained with graders and water tankers.
(Para - 10.37)

ANNEXURES

(A) OUTPUT OF SKILLED AND UNSKILLED LABOUR FOR THE TYPE WORK IN CUM. IN 8 HOURS

Sl. No.	Name of State	Skilled Labour		Unskilled Labour		
		Stone Masonry	Brick Work	Ordinary Soil Evp.	Soft rock	Hard rock
	Andhra Pradesh	4.0	1.0	2 to 3	1.33	0.67
	Gujarat	0.47 to 3	0.8 to 5	1.5 to 3	1 to 2	0.75 to 0.8
	Haryana	0.05 to 1.14	1.7 to 2.00	1.7 to 4.8	3.58	2.0
	Karnatka	1 to 2	1 to 3	1 to 3	0.5 to 2	0.2 to 1
	Madhya Pradesh	0.9 to 1.15	0.76 to 1.2	2.0 to 2.7	0.47 to 0.86	0.25 to 0.26
	Maharashtra	1 to 2.5	1.25 to 3	3.25	0.5 to 2	2 to 3
	Orissa	0.25 to 4	0.3 to 5	1 to 3	0.3 to 1	0.2 to 3.0
	Punjab	3.00 ..... Not available.....				
	Rajasthan	N.A.	1.13 to 2.10	5.6 to 8.6	N.A.	N.A.
	Tamil Nadu	0.56 to 1	0.7 to 1	2.5 to 4	1.0	0.2 to 0.7
	Uttar Pradesh	1.0	1.0 to 1.25	2.0	0.75	0.50
	West Bengal	0.8 to 1	1.42 to 1.7	2.6 to 3.5	1.13 to 2	0.6 to 1

(B) AVERAGE OUTPUT PER DAY UNDER E.G.S. ON PAITHON RIGHT BANK CANAL JAYAKWADI PROJECT

Item	Unit	Average output of Unskilled Labour
Excavation in Soft Soil	m^3	
Lead upto 35 m		0.81
Lead upto 50 m		0.65
Lead upto 125 m		0.49
Excavation in Hard muram		
Lead upto 80 m		0.38
Excavation in Soft rock		
Lead upto 65 m		0.24
Lead upto 150 m		0.21

(C) LABOUR CONSTANTS BASED ON STUDIES CONDUCTED BY THE CENTRAL BUILDING RESEARCH INSTITUTE;ROORKEE FOR WORKS IN NORTH ZONE WHICH COMPRISES OF THE AREAS IN PUNJAB,HARYANA,DELHI,UTTAR PRADESH AND RAJASTHAN(I.S. 7272 (PART-I)- 1974).

Sl. No.	Description of work	Unit	Labour	Recommended constant in days(8 working Hrs.)
1.	a) Excavation over areas (Hard and dense soil) depth upto 1.5m and removal(upto one metre from edge)	m^3	Mate Mazdoor	0.06 0.62
	b) Extra over item (a) for an additional depth of 1.5 m to 3 m	m^3	Mate Mazdoor	0.01 0.11
	c) Extra over item (a) for every additional lead of 25m beyond one metre upto 250 m and deposit to level of 1.5 m	m^3	Mate Mazdoor	0.01 0.12
2.	Mixing by Machine (Mixer) at banker, Cement Concrete (with 20mm graded coarse aggregate)	m^3	Mazdoor Bhisti Mixer Operator Mixer	0.50 0.10 0.07 0.07
3.	Unreinforced concrete in foundations including mixing, pouring, consolidating and curing - Mixer mixed concrete.	m^3	Mason Mazdoor Bhisti Mixer Operator Mixer Vibrator	0.10 1.63 0.70 0.07 0.07 0.07
4.	Reinforced cement concrete in situ in foundations, footings basis for columns etc., excluding from work and reinforcement.	m^3	Mason Mazdoor Bhisti Mixer Operator Mixer Vibrator	0.17 2.00 0.90 0.07 0.07 0.07
5.	Reinforced Cement Concrete in situ in suspended floors/roofs excluding form work and reinforcement	m^3	Mason Mazdoor Bhisti Mixer Operator Mixer Vibrator	0.24 2.50 0.90 0.07 0.07 0.07

6.	Bar Reinforcement including cutting to length, hooked ends crank or being, hoisting and placing in position, binding with binding wire and holding firmly so as not to be disturbed while placing and ramming of concrete.	Quintal	Barbender Mazdoor	1.0 1.0

(Constants for items (4) to (5) include mixing, pouring conso-, lidating, and curing, does not include fair finish)

THE ORISSA DADAN LABOUR (CONTROL & REGULATION) ACT, 1975

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THE ORISSA GAZETTE
EXTRAORDINARY
PUBLISHED BY AUTHORITY

No. 1737 CUTTACK, WEDNESDAY, OCTOBER 29, 1975/KARTIK 7, 1897

LAW DEPARTMENT
NOTIFICATION
The 24th October, 1975.

No. 13335-Legis. The following Act of the Orissa Legislative Assembly having been assented to by the President on the 8th October, 1975, is hereby published for general information:

ORISSA ACT 42 OF 1975

THE ORISSA DADAN LABOUR (CONTROL AND REGULATION)ACT,1975

AN ACT TO REGULATE THE RECRUITMENT OF LABOURERS FROM THE STATE TO WORK OUTSIDE THE STATE AND FOR MATTERS INCIDENTAL THERETO

Be it enacted by the Legislature of the State of Orissa in the Twenty Sixth Year of the Republic of India as follows:-

CHAPTER-I
PRELIMINARY

Short title extent and commencement.

(1) This Act may be called the Orissa Dadan Labour (Control and Regulation) Act, 1975.

(2) It extends to the whole of the State of Orissa.

(3) It shall come into force on such date as the State Government may, by notification, appoint and different dates may be appointed for different provisions of this Act.

Definitions.

2. In this Act, unless the context otherwise requires:-

(a) "Agent" means a person who recruits dadan labourers on behalf of an employer for any work carried on outside the State of Orissa and includes a Contractor, Sub-Contractor, Khatedar, Sardar and persons with similar designation who make such recruitment;

(b) "Chief Inspector" means the Chief Inspector appointed under Section 13;

(c) "Competent authority" means a Competent Authority appointed under Section 12;

(d) 'Dadan Labourer' means a person recruited on the basis of a Contract (either express or implied) from State of Orissa for doing any skilled, semi-skilled or un-skilled manual work outside the State;

(e) "Employer" means the person for whom a dadan labourer is under the terms of an agreement(either express or implied), bound to work;

(f) "Establishment" in relation to an agent means the place or places where any records relating to the agency are kept;

(g) "Inspector" means an inspector appointed under this Act;

(h) "Prescribed" means prescribed by rules made under this Act;

(i) "Registering Authority" means the registering authority appointed under section 3;

(j) "Registration Certificate" means the certificate of registration granted under Section 5;

(k) "Rules" means rules made under this Act.

CHAPTER-II
Registration of Agents

ppointment f Registering uthority.

3. The State Government, may by an order notified in the official Gazette -

a) Appoint an officer or officers, as they think fit to

be registering authorities for the purposes of this Chapter; and

(b) Define the limits, within which a registering authority shall exercise the powers conferred on him by or under this Act,

No person to act as an Agent without registration.

4. No person shall, after the commencement of this Act, act as an agent without being registered as such and except under and in accordance with a registration certificate issued in that behalf.

Registration of Agents.

5. (1) Every agent who is acting as such immediately prior to the commencement of this Act shall make an application within sixty days from the said date, to the registering authority in the prescribed manner for his registration.

Provided that the registering authority may entertaining any such application or registration after expiry of the said period, if it is satisfied that the applicant was prevented by sufficient cause from making the application in time.

(2) Any person who desires to act as an agent may also make an application for his registration to the registering authority in the prescribed manner.

(3) Every application for registration shall be made in such form and shall be accompanied by such fees as may be prescribed and shall be presented in the office of the registering authority.

(4) Where the application for registration is complete in all respects the registering authority shall register the agent and issue to the agent a certificate of registration containing such particulars as may be prescribed and shall enter the particulars relating to the agent as contained in the application for registration in a register to be maintained in the prescribed form.

(5) A registration certificate shall be valid till the end of a calender year during which it is issued and may be renewed for a period of one year on presentation of an application to the registering authority in such form and on payment of such fees may be prescribed and every such application shall

be presented not less than two months before the expiry of the registration certificate.

Provided that the registering authority may entertain an application for the renewal of a registration certificate after the last date for presentation of the application if the application is made before the expiry of the registration certificate and is accompanied by an additional fee equal to twenty-five percent of the fees for renewal.

(6) Where the application is not complete in all respects, the registering authority shall return the same to the applicant within fifteen days of receipt of the application pointing out the defects for rectification and re-submission within fifteen days of its receipt by the agent.

Revocation of Registeration in certain cases.

6. If the registering authority is satisfied, either on a reference made to it in this behalf or otherwise, that:

(a) the registration of the agent has been obtained by misrepresentation or suppression of any material fact; or

(b) the agent has contravened any of the provisions of this Act or the rules made thereunder; or

(c) for any reason the registration has become useless or ineffective and therefore, requires to be revoked, he may, after giving an opportunity to the agent to be heard, revoke the registration.

Appeal.

7. (1) Any person aggrieved by an order made under section 5 or section 6 may, within thirty days from the date on which the order is communicated to him, prefer an appeal to an appellate authority appointed in that behalf by the State Government.

Provided that the appellate authority may entertain the appeal after the expiry of said period of thirty days, if it is satisfied that the appellant was prevented by sufficient cause from filling the appeal in time.

(2) On receipt of an appeal under sub-section (1) the appellate authority shall, after giving the appellant an opportunity of being heard, dispose off the appeal as expeditiously as possible.

Register to be maintained by a registered agent.

8. Every registered agent shall maintain a register in the prescribed form showing:

(a) the name, father's name, age and address of the dadan labourer recruited by him;

(b) the name and address of the employer;

(c) place and nature of work;

(d) brief description of the agreement; and

(e) such other particulars as may be prescribed.

CHAPTER-III

Conditions of Recruitment and Welfare of Dadan Labourer

Conditions of recruitment of dadan labourer.

9. (1) No agent shall recruit any dadan labourer without entering into an agreement with him in the prescribed form.

(2) The recruitment of a dadan labourer shall be subject to the following terms and conditions, namely:

(a) the rate of wages payable to the dadan labourer shall in no case be less than the minimum rate of wages fixed under the minimum wages Act, 1948 (11 of 1948) respect of employees engaged in work similar in nature to that performed by the dadan labourer and in relation to the local area wherein such labourer is required to work;

(b) the conditions relating to hours of work, day of rest and payment for work on a day of rest shall not be less favourable than those provided for under the aforesaid Act in respect of employees engaged in work similar in nature to that performed by the dadan labourer and in relation to the local area wherein such labourer is required to work; and

(c) Such other conditions as may be prescribed.

Liability to work to be extinguished on expiry of the period of agreement.

10. The liability to work under the agreement between the agent and the dadan labourer shall stand extinguished on the expiry of the period specified in such agreement.

Provided that the extinguishment of the liability to work shall in no way affect the other rights and liabilities of the parties to the agreement.

Liability of the agent to pay the recovery of dues of labourer.

11. The agent shall be liable for payment of all dues accuring to a dadan labourer in accordance with the terms of the agreement.

12. (1) The State Government may, by notification in the official Gazette, appoint any office of the Labour Department of the State Govt. not below the rank of an Assistant Labour Commissioner or any other officer with Judicial experience as a Judge of Civil Court or any Sub-divisional Judicial Magistrate to be the competent authority having jurisdiction over such area as may be specified in the notification to hear and decide claims arising out of any agreement entered into between the agent and the dadan labourer in pursuance of section 9.

(2) Where any agent or any dadan labourer has any claim of the nature referred to in sub-section (1), the claimant himself, or any person authorised by him in writing in this behalf or in the case of the death of the claimant, any member of his family or an inspector may, without prejudice to any other mode of recovery, make an application to the competent authority for computation of the dues of the claimant.

Provided that every such application shall be presented within six months from the date on which the dues become payable.

Provided further that an application may be entertained by the competent authority after the expiry of the said period of six months if it is satisfied that the claimant

was prevented by sufficient cause from making the application in time.

(3) When any application under sub-section (2) is entertained, the competent authority shall after giving the concerned parties and such other persons as it considers to be interested a reasonable opportunity of being heard and after making such further enquiry as it may consider necessary compute the dues of the claimant.

(4) If the competent authority, while hearing an application under this section is satisfied that the application is either malicious or vexatious, it may direct that a penalty not exceeding fifty rupees be paid to the person against whom the claim is made by the person presenting the application.

(5) Any amount due to the claimant as computed by the competent authority may be recovered-

(a) If the competent authority is a Magistrate, by it as if it were a fine imposed by it as Magistrate, or

(b) If the competent authority is not a Magistrate, by the issue of a certificate by it for that amount to the Collector, and the Collector shall proceed to recover that amount in the same manner as an arrear of public demand.

(6) All orders made under this section shall be final and shall not be liable to be challenged in any Court.

(7) Every competent authority appointed under sub-section (1) shall have the same powers as are vested in a Court under the code of Civil Procedure, 1908 when trying a suit in respect of (5 of 1908):-

(a) Summoning and enforcing the attendance of witnesses and examining them on oath;

(b) requiring the discovery and production of documents;

documents;

(c) receiving evidence on affidavit; and

(d) such other matters as may be prescribed.

(8) Every competent authority shall be deemed to be a Civil Court for the purposes of Section 195 and Chapter XXVI of the Code of Criminal Procedure, 1973.

2 of 1974

CHAPTER-IV

APPOINTMENT, POWERS AND DUTIES OF CHIEF INSPECTOR AND INSPECTORS

Appointment of Chief Inspector and Inspectors.

(1) The State Government may, by notification, appoint a Chief Inspector who shall be the Chief Executive Authority for the purpose of carrying out the provisions of this Act.

(2) The State Government may, by notification, appoint such persons as they think fit to be inspectors for the purposes of this Act and define the local limits within which they shall exercise their powers under this Act.

(3) In addition to any power conferred on the Chief Inspector by or under this Act, he may exercise all or any of the powers of an inspector.

Powers of Inspector.

14. (1) Subject to the rules made in this behalf,, an Inspector may, within the local limits of his jurisdiction :-

(a) make such examinations of the records and registers maintained by an agent and take the statement of any person as may be deemed necessary for carrying out the provisions of this Act.

(b) seize or take copies of such records as he may consider relevant in respect of an offence which he has reasons to believe to have been committed under this Act.

(c) exercise such other powers as may be prescribed.

(2) Any person required to produce any document or thing or to give any information required by an inspector shall be deemed to be legally bound to do so within the meaning of section 175 and section 176 of the Indian Penal Code.

(45 of *1)

15. Inspectors to be public servants. — The Chief Inspector and every Inspector appointed under Section 13 shall be deemed to be a public servant within the meaning of section 21 of the Indian Penal Code.

(45 of 1860)

16. Agent bound to produce records. — (1) Every agent shall, on demand, produce for inspection by an Inspector all registers and records required to be kept under this Act and the rules made thereunder.

(2) Where the agent fails to produce for inspection any register or record before an inspector on demand, it shall be presumed that the agent has no register or record to produce and the inspector shall proceed with the inspection accordingly.

CHAPTER-V
PENALTIES AND PROCEDURES

17. Offence. — Whoever contravenes any of the provisions of this Act, shall be punishable with imprisonment for a term which may extend to six months, or with fine which may extend to one thousand rupees, or with both.

18. Cognizance of offences. — (1) No prosecution under this Act shall be instituted except with the previous sanction of the Chief Inspector.

(2) No court shall take cognizance of any offence punishable under this Act, save on complaint made by an Inspector or the Chief Inspector.

CHAPTER-VI
MISCELLANEOUS

19. Protection of actions taken under this Act.

(1) No suit, prosecution or other legal proceeding shall lie against any officer of the Government for anything which is in good faith done or intended to be done in pursuance of this Act or any rule or order made thereunder.

(2) No suit or other legal proceeding shall lie against the Government for any damage caused or likely to be caused by anything which is in good faith done or intended to be done in pursuance of this Act or any rule or order made thereunder.

20. Powers to make rules.

(1) The State Government, may subject to the condition of previous publication, make rules for the purpose of carrying out the provisions of this Act.

(2) In particular and without prejudice to the generality of the foregoing power, such rules may provide for all or any of the following matters, namely:-

(a) the form and manner of making an application to the registering authority for registration of an agent;

(b) fees for registration and renewal of registration of an agent;

(c) the form and manner of making application for renewal of registration of an agent;

(d) form of registration certificate to be issued to the agent;

(e) the records and registers to be maintained by an agent for the purpose of securing compliance with the provisions of this Act and the rules made thereunder and the particulars to be entered therein;

(f) the form of agreement to be entered into between the agent and the dadan labourer;

(g) other particulars and conditions to be fulfilled with regard to recruitment of dadan labourers;

(h) the submission of returns by the agent to the registering authority;

(i) the powers which may be conferred on the Inspectors and the Chief Inspector under this Act and their functions;

(j) form of register to be maintained by the registering authority; and

(k) any other matter which is required to be, or may be prescribed.

(3) All rules made under this Act shall, as soon as may be after they are made be laid before the State Legislature for a total period of fourteen days which may be comprised in one session or in two or more successive sessions and if during the said period the State Legislature makes modifications, if any, therein, the rules shall thereafter have effect only in such modified form; so, however that such modifications shall be without prejudice to the validity of anything previously done under the rules.

By order of the Governor

L.MOHAPATRA
Secretary to the Government.

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ANNEX-III

EMPLOYMENT GUARANTEE SCHEME IN MAHARASHTRA

Employment Guarantee Scheme was initially sponsored by Government of Maharashtra in March, 1972. The aim of this Scheme is to minimise the widespread unemployment and underemployment and the resultant poverty in rural areas. At the time, the scheme was sanctioned and introduced in Maharashtra, scarcity works were in progress in all the five Districts of the Marathawada area (i.e. Aurangabad region) which were last continued upto December, 1973. After closure of scarcity works, the Employment Guarantee scheme works were started wherever possible with the available staff of this Department. The works which were initially proposed to be started under this scheme were mostly unskilled portion of incomplete works started under scarcity.

As per orders of the State Government in Planning Department the unskilled components of Major, Medium and Minor Irrigation works including percolation and village tanks were taken up under Employment Guarantee scheme. These unskilled components mostly include Excavation and raising of banks of Dams and Canals. In the initial stages priority was given to start the works of M.I. Tanks and percolation tanks only. But from July, 1975 the unskilled components of Major and Medium Projects were also taken up. Subsequently Government in Irrigation Department during October, 1975 have directed to take up major components of Minor Irrigation Tanks under E.G.S. except masonry and concrete items where sufficient skilled labour is required. Accordingly efforts were made to start maximum number of schemes under E.G.S., which are administratively approved by Government, with the help of available staff. Since August, 1975 excavation of Jayakwadi Canals in Aurangabad, Bhir and Parbhani Districts is also in progress under E.G.S. and thereby substantial progress is achieved within a short period of about a year from E.G.S. funds.

Table showing the works and expenditure done during the last 3 years in the Marathawada region will throw the adequate light on the achievements under the E.G. Scheme.

Year	No. of works	Man days in lakhs	Expenditure in lakhs
1975-76	697	137.47	362.49
1976-77	353	236.82	940.28
April, 1978	381	-	52.64

Maximum wage earned by labourers during the last 1½ years worked out to Rs. 6/- per day depending upon the work turned out by the gangs.

Average wages worked out to Rs. 2.50 to 3.50 per day.

From the experience gained during last 1½ years, it has to be concluded that unemployment is reducing slowly and the financial position of the labourers is improving. Any able bodied worker is now sure of getting work and he is confident to get reasonable wages by doing maximum work.

Annexure-IV

EMPLOYMENT SCHEME

Right to Work

Government of Gujarat
General Administration Department (Planning)
Resolution No. : EMP-1069-1522-J
Sachivalaya, Ahmedabad

Dated the 20th August, 1969.

RESOLUTION:

The question of evolving a scheme to provide employment to workers who are in need thereof was under consideration of Government. It is now decided to formulate a scheme 'Right to Work' - to provide employment opportunities to workers who are seeking employment. The unemployed workers will be provided with jobs on multipurpose, major, medium and minor irrigation works, the Capital Project, road works or soil conservation works. Details of the works taken up or proposed to be taken up in the Fourth Plan which will provide employment opportunities showing the districts, in which the works are located and the total requirements of labour per year are given in the Statement - appended hereto : (statements are not appended).

2.0 The schemes of minor irrigation and district level roads are transferred to Panchayats which execute these works through contractors. Multi-purpose, major and medium works and the works in connection with the Capital Project are executed by Government, also through Contractors. Public Works Department should, therefore, immediately finalise a working arrangement with the Panchayats and the contractors for the employment of unemployed workers seeking jobs, so that the scheme can be implemented from 2nd October, 1969. Such arrangements necessitating any new procedures/and/or forms will be feasible straightway under Rule 95 of the Gujarat Taluka and District Panchayats Financial Accounts and Budget Rules, 1963.

3.0 The Superintending Engineers incharge of the multipurpose major and medium irrigation projects should report to the Planning Adviser, General Administration Department (Planning) on the 1st September, 1969, the number of unskilled works that can be employed on the basis of availability of vacancies on that date on each of the irrigation works. The information should be given separately for each multipurpose, major and medium scheme. The Chief Engineer in-charge of the Capital Project should give similar information for the Capital Project and the quarry at Sevalia. Similar information for minor irrigation works and road works in charge of Panchayats should be supplied by the District Development Officers to the Planning Adviser, General Administration Department (Planning) also on the 1st September, 1969. The Joint Director of

Agriculture - in-charge of Soil Conservation should supply similar district-wise information in respect of Soil Conservation Schemes. Similar subsequent monthly reports should be sent thereafter on the 1st of each month by each of the officers mentioned above.

4.0 Information in respect of skilled works, like masons carpenters, plumbers, etc., should be given separately by the above mentioned officers on 1st September, 1969 and thereafter on the 1st of each month.

By order and in the name of the Governor of Gujarat

Sd/-
(R.N. DESAI)
Under Secretary to the Govt. of Gujarat,
General Administration Department (Planning).

To

The Secretary to Governor of Gujarat.

The Secretary to Chief Minister.

Personal Secretary to all Ministers.

Personal Assistants to all Deputy Ministers and Parliamentary Secretaries to Chief Ministers.

All Departments of the Secretariat.

All Heads of Departments (on mailing list of Planning Section).

Circle Engineer to Government P.W.D. (R&B).

Circle Engineer to Government (Irrigation Projects).

Circle Engineer to Government (Irrigation)

Circle Engineer to Government (Capital Project).

All Superintending Engineers.

Joint Director of Agriculture

All Collectors.

All District Development Officers.

All Branches in General Administration Department.

PROFORMA-'A'

Report on the scheme for employment of unskilled labourers as on 1st of_____

Sector of Development_____ Name and Designation of the reporting Officer_____

Name of the District	Name of the Project	Location	Talukas	Required No. of workers	Workers already on job	Number of vacancies	Remarks
1	2	3	4	5	6	7	8

PROFORMA-'B'

Report on the scheme of Employment of skilled workers as on 1st of_____

Sector of Development_____ Name and designation of the reporting Officer_____

Name of the District	Name of the Project	Location	Talukas	Category of skilled workers	Required numbers	Workers already on job	Number of vacancies	Remarks
1	2	3	4	5	6	7	8	9

(Illustrative list)

Carpenters

Masons

Plumbers

Wiremen

Fitter

Turner

Moulder

Welder

Painter

ANNEXURE-V

Assessment of actual liability on a direct wage payable to Employees:

(A)			
	1. Weekly day of rest	52 days/year	
	2. Leave privilege-one day for 20 days of work	18 days/year	
	3. Casual/Sick Leave	7 days/year	
	4. Paid Holidays	10 days/year	
		87 days/year	
	As a percentage this works out to $\frac{87 \times 100}{278}$ =		31.29%
(B)	1. Retrenchment compensation.		
	15 days wages per year of service. (Year to be reckoned as minimum 240 working days	15 days	
	2. Average Notice pay		
	(Notice pay is 30 days wages irrespective of service of a worker)	30 days	
		45 days/year	
	$\frac{45 \text{ days}}{278} \times 100$ =		16.19%
(C)	Accommodation as percentage of Labour emoluments.		20.00 %
			67.48 %
(D)	Travelling (Annual to and fro)		10.00 %
(E)	Medical expenses or benefits		4.00 %
(F)	Workman's compensation. Actually the present promium is 15% but it averages out to about 5% due to floating labour.		5.00 %
(G)	Free Water supply and Power		3.00 %

(H)	Subsidised ration		2.00 %
(I)	Indirect labour i.e. services like mess services.		5.00 %
(J)	Free dresses, gum boots, helmets, woollens, mess utensils.		3.00 %
			99.48 %
		Say	100.00 %

ANNEXURE-VI

LIST OF MACHINES/EQUIPMENT

Sl.No.	Name of Machine:
1.	Drill Jumbo
2.	Jack hammer
3.	Wagon drill
4.	Scalling hammer
5.	Drill Steel (a) for Wagon drill (b) for Jack hammer
6.	Locomotive diesel
7.	Locomotive battery
8.	Muck car
9.	Shotcrete machine
10.	Drilling machine
11.	Convey mucker
12.	Overhead Loader
13.	Front and loader
14.	Pusher leg
15.	Auto feed
16.	Pneumatic concrete placer
17.	Grouting machine
18.	Ventilation blower
19.	Agitating car
20.	Diesel shovel (2.0 cum)
21.	Electric shovel
22.	Air Compressor diesel - 210 c.f.m.
23.	Air Compressor diesel - 300 c.f.m.
24.	Air Compressor diesel - 500 c.f.m.
25.	Air Compressor Electrical - 500 c.f.m.
26.	Air Compressor Electrical - 1500 c.f.m.

27. D-8 class Tractor dozer
28. D-9 class Tractor dozer
29. 35t rear dumper
30. Hydraulic excavator
31. Dumper (15T)
32. Tipper Truck (7t)
33. Crushing & processing plant
34. Batching & mixing plant
35. Mobile crane 10t
36. Electrical pump-50 H.P.
37. Electrical pump-15 H.P.
38. Shutter - 6.0 m long
39. D-4 Tractor with Turindrum sheep foot roller
40. Ropeway
41. Vibratory rollers
42. Pneumatic tyred rollers.

LIFE AND REPAIR PROVISION OF EQUIPMENT

Sl. No.	Equipment		Life of Equipment		Repair provi. (%age of cost of Equipment)	Remarks
	Category	Capacity	Years	Hours		
1	2	3	4	5	6	7
1.	Excavators	Upto 1.5 cuyds.	10	12,000	150	
	Shovels & Draglines	1.5 to 3.0 cu. yds.(Diesel)	12	15,000	150	
		Above 3.0 cuyds. (Diesel)	15	25,000	150	
		2.5 to 4 cuyds. (Electric)	15	25,000	150	
		4 cuyds. & above (Electric)	20	40,000	150	
	Walking Draglines.		20	30,000	150	
	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	
2.	Dumpers					
	Bottom Dumpers	Upto 20 T	8	10,000	140	
		20 T to 50 T	10	16,000	140	
		Above 50 T	12	20,000	140	
	Rear Dumpers	Upto 15 T	8	10,000	140	
		15T to 35T	10	12,000	140	
		Above 35T upto50T	12	15,000	140	
		50 T above	15	20,000	140	

1	2	3	4	5	6
	Highway Dumpers		8	10,000	140
3.	Scrapers:				
	A.Motorised.				
	Push	Upto 10 cuyds.	8	9,000	150
	Loaded	Above 10 cuyds.	10	10,000	150
	Elevating and Self Loading		10	10,000	150
	B.Towed		12	15,000	75
4.	Tractors:				
	Crawler	Upto 100HP	8	9,000	200
		Above 100 to 300 HP.	10	12,000	240
		Above 300 HP	12	16,000	240
	Wheeled	Upto 75 HP	8	12,000	150
		Above 75	10	15,000	150
5.	Graders:		10	12,000	150
6.	Loaders:				
	Crawler		10	12,000	200
	Wheeled		10	15,000	150
	Belt Loaders		16	20,000	70
	Reclaimers & Stackers		20	30,000	70
7.	Compactors:				
	Self propelled Sheepafoot Rollers		10	12,000	80
	Drawn Sheepafoot Rollers		8	10,000	70
	Vibratory Rollers		8	8,000	150
	Smooth drum Rollers		8	10,000	80

1	2	3	4	5	6	7
	Smooth drum Vibratory Rollers		8	8,000	150	
	Pneumatic tyred Rollers		8	10,000	80	
	Highspeed Compactors		10	16,000	100	
8.	Water Sprinklers		10	16,000	100	
9.	Canal Trimmer; and lining Equipment above 200 cuyds/ Hr.		16	20,000	180	
10.	Drills:					
	Blast hole drills		10	10,000	80	
	Core Drills		8	8,000	80	
	Wagon Drills		8	8,000	80	
	Tricone rotary D Drills		10	10,000	80	
11.	Compressors:					
	A.Diesel Compressors.					
	i)Portable upto 300 c.f.m.		8	10,000	100	
	ii)Portable above 300 c.f.m.		10	12,000	100	
	B.Electric Compressors.					
	i)Portable upto 300 c.f.m.		10	16,000	80	
	ii)Portable above 300 c.f.m.		12	20,000	80	
	iii)Stationery		20	30,000	80	
12.	Blowers		12	-	80	

1	2	3	4	5	6	7
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 & Mixing Plant	18	30,000	75	
	ii)	Transit Mixers	10	10,000	120	
	iii)	Agitating Cars	10	10,000	120	
	iv)	Portable Concrete mixers.	5	6,000	80	
15.	Pumps:					
	i)	Diesel Engine	8	10,000	100	
	ii)	Electrical	12	20,000	70	
16.	Well Points		12	20,000	100	
17.	Cranes:					
	i)	Mobile (Pneumatic Wheeled)	12	12,000	120	
		4 to 6 tons	10	12,000	120	
		8 to 12 tons	10	12,000	120	
		15 to 25 tons	12	15,000	120	
		26 tons & above	12	15,000	120	
	ii)	Crawler Mounted				
		Upto 3 tons	10	12,000	120	
		4 to 10 tons	10	12,000	120	
		Over 10 tons	12	15,000	120	
	iii)	Tower Cranes	20	30,000	120	
	iv)	Truck mounted	10	16,000	140	
18.	Transport Equipment:					
	A.	Heavy Transport vehicles.				
	a)	Trucks & Highway Dumpers.				
	i)	Diesel upto 3 T	10	2,00,000 Km.		140
		Diesel 3 to 5 T	10	2,00,000 Km.		140
		5 T and above	10	2,00,000 Km.		140

1	2	3	4	5	6	7
	b)Tractor Trailers					
	upto 5 T		10	2,50,000 Km.	140	
	5 T to 10 T		10	2,50,000 Km.	140	
	10 T and above		12	20,000 Hrs.	140	
	B.Light Transport Vehicles.					
	i)Jeeps			1,60,000 Km.	140	
	ii)Station Wagons			1,60,000 Km.	140	
	iii)Cars			1,60,000 Km.	140	
	iv)Ambulance cars			1,60,000 Km.	140	
	C. Aerial Transport					
	i)Ropeways		20	40,000	70	
	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	
19.	Diesel Generating Sets.					
	Upto 50 Kvs.		10	20,000	100	
	Above 50 Kvs		15	30,000	120	

ANNEX.VIII

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

Sl. No.	Name of Equipment	Operation & maintenance crew required ror the operational of the M/C									
		Fore-man	Opera-ter	Mech-anic	Helper	Watch-man	Elect-rician	Super-visor	Dri-ver	Cable-man	Beldar
1	2	3	4	5	6	7	8	9	10	11	12
1.	Drill Jumbo	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 con-crete placer	1/8	1	1/6	1	1/6	-	-	-	-	-

1	2	3	4	5	6	7	8	9	10	11	12
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 H.P.	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 H.P. 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 H.P.	1/8	1	1/4	1	1/4	-	-	-	-	-
25.	Air Compressor (Electric,500cfm 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	-	-	-	-
27.	D-8 class Tractor Dozer (HP 270)	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 Ex-cavator(1.25 cu. yd. HP 103.50)	1/4	1	1/4	1	1/4	-	-	-	-	-

1	2	3	4	5	6	7	8	9	10	11	12
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 H.P.)	1/8	1	1/4	1	1/8	-	-	-	-	-
42.	Pneumatic Tyred Roller	1/8	1	1/4	1	1/8	-	-	-	-	-

ANNEXURE-IX

THE CONSTITUTION OF THE PURCHASE COMMITTEES IN SOME OF THE STATES FOR PURCHASE OF MACHINERY, EQUIPMENT ETC REQUIRED FOR IRRIGATION PROJECTS

Sl. No.	Name of the State	Members of the Purchase Committee	Powers delegated to Purchase Committee	Powers of Local Purchase delegated to Officers of Irrigation Department.	Remarks
1	2	3	4	5	6
1.	Gujarat	i) Concerned Chief Engineer and Joint Secretary ii) O.S.D. (M.I.C.C.) iii) Chief Engineer of the Concerned project (if any) iv) Superintending Engineer Narmada (Mechanical Circle) v) Superintending Engineer Ukai (Mechanical Circle) vi) C.S.P.O. Ahmedabad vii) Financial Adviser.	Immediate requirements of machinery & equipment for all Major, Medium & Minor irrigation Projects of the State except Narmada Project and Engineering Research Institute Baroda. i) Committee shall scrutinise & finalise purchases upto Rs. 25 lakhs estimated cost at a time where lowest offer is acceptable. ii) In case where second lowest offer is acceptable purchases upto Rs. 1 lakh only. iii) Committee shall place its recommendations before purchase	i)Committee to meet once in a month. ii)Purchase through Commttee to be initiated after obtaining a Certificate of Non-availability in the State of the equipment required from O.S.D. (M.I.C.C.) iii)Manufacturer's and suppliers registered with C.S.P.O. Ahmedabad) and D.G.S.&D. New Delhi be only allowedto quote.	

1	2	3	4	5	6
		Committee at Secretary's level and act as per its direction in respect of:- a) Where estimated Cost of Equipment is more than Rs.25 lakhs. b) Where offer of other than first and second lowest to be considered. c) Where estimate cost of equipment is more than Rs. 1 lakh but less than Rs. 25 lakhs and the case is for acceptance of 2nd lowest offer.			
2. Uttar Pradesh		I. High level Central Purchase Committee. i) Engineer in Chief, Irrigation Department. ii) Secretary Irrigation Deptt., or an officer nominated by him. iii) Secretary Finance Deptt.,or an officer nominated by him.	As under Col.(5)	Direct purchase at a time under by officers of Irrigation Deptt., including officers of Workshop circle but excluding Major Projects having their own purchase organisation of 65 items of equipment & stores of specialised	i)At least one Chief Engineer (Director) to be present in the meeting of the Committe. ii)Quorum of 3 members of Committee required. iii)Limited short tenders to be

1	2	3	4	5	6
		iv) Concerned Chief Engineer/Director v) Director of Industries or an officer nominated by him, vi) Superintending Engineer(equipment) vii) A Senior Accounts Officer attached to the office of the Engineer-in-Chief.	nature required for construction without obligation to purchase them through store purchase section of Industries Directorate U.P. 1. Alter inviting tenders/ Quotation in any Calender month, i)Assistant Engineer NIL ii) Executive Engineer upto 6000 in any calendar month iii) Superintending Engineer (Workshop Circle) upto 50,000 iv) Superintending	issued in very urgent cases to few selected firms out of those registered with D.G.S & D or Director of Industries. iv) If purchase is not proposed to be made from lowest valid tender, the purchase to be approved by next higher authorities. v) Items manufactured by Irrigation Workshop circle to be purchased from them only.	

1	2	3	4	5	6
				Engineer Upto 15,000 in any calender month. Proprietary articles from accredited agent of equipment Single Quotation:- Same as above by Officers at (i) & (ii)	
				Superintending Engineer (Workshop Circle) upto 15000 in any calandar month.	
				2. Director Purchase of the officers of Central procurement organisation for purchase of stores, spare part and equipment & purchases against rate contract by Director of Industries or D.G.S. & D.	
				1) Executive Engineer Procurement upto Rs. 25000	

1	2	3	4	5	6
				ii) Superintending Engineer procurement upto Rs. 3 lakhs.	
				iii) Chief Engineer/ Director concerned upto Rs. 20 lakhs.	
				iv) Purchase Committee upto Rs. 1 crore.	
				v) State Government (Full Powers).	
				For purchases against rate contracts of Director of Industries or D.G.S.&D. Chief Engineer/Director will exercise full powers.	
				3. Purchase of articles of propriety nature: i)Executive Engineer (Procurement) upto Rs. 5,000	
				ii)Superintending Engineer upto Rs.50000 (Procurement) upto Rs.50000	

1	2	3	4	5	6
				iii) Chief Engineer/ Director Rs. 2 lakhs	
				iv) Purchase Committee Rs. 3 lakhs	
				v) State Government (Full Powers)	
		II. Regional Purchase Committee for projects under Tehri Project & Yamuna Project Organisation.		4. Purchase of Stores and spares through limited short enquiry issued to selected suppliers for urgent purchase.	
		i) Additional Chief Engineer Yamuna Project		i) Superintending Engineer (procurement) upto Rs. 30,000	
		ii) Additional Chief Engineer Tehri Project		ii) Chief Engineer/ Director concerned upto Rs. 1 lakh.	
		iii) Senior Accounts Officer Irrigation Department.		iii) Purchase Committee upto Rs. 2 lakhs.	
		iv) Concerned Superintending Engineer.			
		v) Representative of the Director of Industries nominated by him.			

1	2	3	4	5	6
		III. Project Sub-Purchase Committee i) Concerned Superintending Engineer. ii) Another Superintending Engineer nominated by the Concerned Addl. Chief Engineer. iii) Concerned Executive Engineer. iv) Officer nominated by the Director of Industries.		iv) State Government Full Powers.	
				i) Direct purchases on the basis of tenders/quotations and items under Rate Contract approved by the Director General Supplies & Disposal, New Delhi and the Director of Industries Deptt. Kanpur. Project Sub-purchase Committee - Rs. 3 lakhs Regional Purchase Committee - Rs. 20 lakhs Departmental Central Committee - Rs. 100 lakhs Government - Full Power Note:- Concerned Additional Chief Engineer will have full powers for making purchases under Rate Contract entered by D.G.S&D, New Delhi and Director	

1	2	3	4	5	6
				of Industries, Kanpur.	
				ii) Purchases of the proprietary articles:	
				Project Sub-purchase Committee - Rs. 50000	
				Regional Committee - Rs. 2 lakhs	
				Departmental Central Committee - Rs. 3 lakhs	
				Government Full Power,	
				iii) Purchase on basis of short term tenders/quotations received from selected selling Agents:-	
				Project Sub-purchase Committee - Rs. 50000	
				Regional Committee - Rs. 1 lakh	
				Departmental Central	

1	2	3	4	5	6
				Committee - Rs. 2 lakhs Government - Full Power	
3.	Maharashtra	i) Chief Engineer (project) and Joint Secy., Irrigation Department. ii) Managing Director Irrigation Development Corporation of Maharashtra, Pune. iii) Superintending Engineer Mechanical Circle (C.P.) Nanded. iv) Superintending Engineer Mechanical Circle (C.P.) Kolhapur. v) Superintending Engineer Mechanical Circle (C.P.) Nanded. vi) Internal Financial Adviser & Deputy Secy., Irrigation Department. vii) Superintending Engineer & Deputy Secretary (I.P.) Irrigation Department.	i) Procurement of machinery & Equipment costing more than Rs.25000 per piece and consisting of (a) all types of heavy earthmoving machines (Imported/ Indigenous). (b)Light construction machinery such as Trucks, Tippers, Water Tankers, Road Rollers and Air Compressers. ii) Procurement of Machinery, equipment Survey instruments and stores costing more than Rs.25,000 per item and not included in (i)above. iii) Procurement of all types of laboratory equipment and apparatus. iv) Procurement of all other items of stores machinery and	1) Purchases against lowest tender for immediate consumption and not stock. i) Executive Engineer upto Rs. 25000 in respect of any one item during financial year. Items occasionally and urgently required upto the the aggregate amount of Rs.1 lakh in a financial year 2) Purchase of spare parts borne on rate contract but not readily available with rate contract holder. i) Executive Engineer Mechanical Division in the Mechanical	

1	2	3	4	5	6
			equipment which are not included in (i) (ii) and (iii) above. Committee to function on the lines of the store Purchase Committee of the Central Store Purchase Organisation and decide procurement of items of Machinery upto aggregate value of Rs.5 lakhs and and items of stores upto aggregate value of Rs. 15 lakhs. Cases where purchase exceeds above limits should be submitted to Govt., for approval before placing final orders.	Organisation-upto Rs.50,000 at a time purchase to the extent of Rs.5 lakhs or 10% of the cost of Machinery which is less per year to meet the urgent requirement. ii)Deputy Engineer of Machanical Sub-Division in the Mechanical Organisation:- upto Rs. 1000 at a time purchase to the extent or Rs.10000 per annum subject to post audit by Divisional Officer.	
4. Madhya Pradesh	1. For purchase of plant & Machinery for Major Projects. i) Finance Secretary ii) Irrigation Secretary iii) Engineer-in-Chief iv) Chief Engineer of the Project.	i) Purchase upto Rs.50 lakhs in each case. For purchases exceeding Rs.50 lakhs cases are to be put up to Major Project Control Board of the State.	i)To invite & accept tenders for works supply of Machinery stores etc., erection etc. against open tenders invited from firms of repute:- Assistant Engineer Rs.2000		

1	2	3	4	5
		v) Chief Engineer E/M		Executive Engineer - Rs. 5,00,000 Superintending Engineer - Rs. 10,00,000 Chief Engineer - Rs. 25,00,000
		vi) Financial Adviser		
		vii) Secretary, Major Project Control Board.		
		2) For purchase of Plant & Machinery for Medium and minor Projects.	2) Purchase upto Rs.25 lakhs For purchases exceeding Rs.25 lakhs are referred to State Government.	ii) Purchased plant & Special Machinery urgently required against single or limited enquiry (excluding vehicle from recognised manufacturers): Executive Engineer - Rs. 5,000 Superintending Enginner - Rs. 20,000 Chief Engineer - Rs. 60,000
		i) Engineer-in-Chief		
		ii) Chief Engineer of the Basin		
		iii) Chief Engineer E/M		iii) Purchase of spares & miscellaneous items on the basis of tenders:- Executive Engineer - Rs. 7,500
		iv) Deputy Secretary Finance Department		
		v) Deputy Secretary Irrigation Department.		

1	2	3	4	5	6
				Superintending Engineer-Rs.15,000 Chief Engineer Rs. 1,00,000	
5. Punjab	Beas Control Board-Stores Purchase Committee: i) General Manager (or in his absence the Chief Engineer) ii) Financial Adviser iii) A representative of Central Water Commission iv) Director, Plant Design Unit I and of Unit II as the case may be. v) Superintending Procurement (now C.P.O.)	1)To deal with proposals when the cost there of exceeds the powers of purchase of General Manager but does not exceed Rs.30 lakhs. 2) Purchases which exceed Rs.30 lakhs, the Committee shall make its recommendations to Standing Committee/Beas Control Board. 3) No repeat orders should be placed if the original order was placed to cover an "Urgent" or Immediate demand. The Enhanced powers upto Rs.30 lakhs in each case are subject to following conditions:	1) Purchases by open tenders Stores-Machinery Asstt. Purchase Officer-Rs.10,000 Purchase Officer Rs.50,000 <u>Chief Purchase Officer</u> Stores Machinery Rs. 2 lakhs Rs. 2 lakhs <u>General Manager/C.E</u> Rs.5 lakhs Rs.5 lakhs <u>Local Purchase Committee</u> Rs.30 lakhs Rs.30 lakhs 2) Purchase by limited tender enquiry: Ch.Pur.Officer Rs.30,000	i) At least three members to be present. ii) No meeting of Committee shall be held if Financial Adviser or his authorised representative is not present. Subject to: Enquiries made from known suppliers all over India

1	2	3	4	5	6
			i) The equipment has been approved by the competent authority as decided by the Board.	Purchase Officer - Rs. 10,000	
			ii) Approval of next higher authority is obtained for accepting tender other than lowest technically acceptable one.	General Manager/ Chief Engineer - Rs. 60,000 consultation with F.A.	
				Local Purchase Committee - Rs. 1,00,000	
			iii) In case where single tender is received it is satisfied that no other firm is in a position to quote (e.g. for strictly proprietary articles with sole agency)	Central Purchase Committee-Full Powers	
				2)Purchase of proprietary articles by Single tender:	
				Chief Purchase Officer - Rs. 10,000	
				General Manager/Chief Engineer in consultation with Financial Adviser - Rs.1,00,000	
				Local Purchase Committee - Full Powers.	
				3)Purchase by Negotiations:	
				Chief Purchase	

1	2	3	4	5	6
			Officer in consultation with F.A.B.P. - Rs.30,000 General Manager/Chief Engineer in consultation with F.A.B.P. - Rs.1,00,000 Local Purchase Committee - Rs.10,00,000 Central Purchase Committee Full Powers.		
			4) Repeat Orders:-		Subject to:-
			Authority next higher to the authority competent to place orders for the value of the original order plus the value of the repeated order.	upto 25% or the original value of the order	i) Repeat order to be placed within 6 month of first order. ii) Discount admissible is secured. iii) No second repeat order to be placed. iv) Prices have not gone down to be certified.
			5) Purchase of stores against Rate Contracts or price agreement existing with D.G.S. & D and Controller		

1	2	3	4	5	6
				of stores Punjab and Purchase of Mathematical equipment available with National Instrument Factory.	
				Chief Purchase Officer - Rs. 5 lakhs	
				General Manager Chief Engineer - Full Powers.	
				Chief Purchase Officer - Full Powers.	

ANNEX. X

Name of the Project _____

Performance Budget for the period _____ to _____

Proforma (1)

PURCHASES

Category of Purchase	Budgeted Quantity	Budgeted Price	Actual Quantity	Actual Price	Significant variation if any and Reasons
1	2	3	4	5	6
i) Steel					
ii) Cement					
iii) Timber					
iv) Tools and Plants					
v) Special Tools and Plants					
Etc.,					
Etc.,					
Gross Total (Value only)					

Note:- i) The actual price will be the price including taxes, duties and the cost of transportation (Where these are payable by the project) in respect of goods actually taken in stock during the budget period.

ii) Variation will cover all the four columns (2) to (5). In an inflationary market there may significant reduction in actual quantity, with small variation in price, but the reduction in volume of procurement will still call for review.

Proforma (2)
Inventory of Stores

Category of Items.	Opening Balance		Receipts	Total	Issue to works etc.		Sales & Disposal				Total of (5+6)	Closing Balance (4-7)	Significant Variation, if any in Column 6 and reasons.
	Qty	Value	Actual Qty. Val.	Actual Qty. Val. (2 + 3)	Actual Qty.	Val.	Bud. Qty.	Val.	Actual Qty.	Val.	Actuals only		
1	2		3	4	5		6		7		8	9	10
i) Steel													
ii) Cement													
iii) Timber													
iv) Tools & Plant													
v) Special Tools and Plants etc.													
Gross Total (Value only)													

Note: i) Under Quantity and Value columns, the totals under each broad category of stores only will come. Details under each broad category are not necessary.

ii) Variation between budgeted and actual receipts will come in proforma (1) and variation between budgeted actual issues will come in proforma (2).

iii) Control of inventory and inventory reduction, when justified will be watched through this proforma supplemented by A.B.C. Analysis of Store Item.

Proforma (3)

Operation of Special Tools and Plant

Category of Item.	Number in each Category.	Operating Hours Budgeted	Operating Hours Actuals	Shut down hours for Running repairs and Major overhauls Budgeted	Shut down hours for Running repairs and Major overhauls Actual	Significant variation, if any, between budgeted and actual hours Col.(3) & reasons	Significant variation, if between budgeted & actuals for Col.(4) and reasons.	Identification of under utilised Machine i.e. whose utilisation is less than 30%
1	2	3		4		5	6	7
Cranes								
Dozers								
Dumpers								
Shovels etc.								

Note: i) Under each category in Column (1), there may be two sub-categories, one for special Tools and Plant which have out lived 50% of any other fixed percentage of their prescribed life and those which are yet to reach the percentage limit. The percentage should be so fixed as to distinguish between T&P for which shut down hours under maintenance programme will be more and those for which those hours will be less.

ii) Operating cost items like fuel, lubricants, Miscellaneous expenditure e.g. cost of fuel filters, oil filters, wages running repairs and indirect items like depreciation and provisions for major over hauls (M.O.H.) have been purposely omitted from the proforma as these columns will make the presentation cumbersome. Intension of this proforma is to assess operating performance in terms of hours. The cost efficiency in terms of expenditure can be assessed separately by a comparative study of the Annual Cost of each individual T&P for a few years.

iii) Under utilised and unutilised equipment should be specifically mentioned in column (7).

Proforma (4)

Inventory of Special Tools & Plant

Category of Special tools and Plants.	Opening Balance Number	Value	New Purchase/ Transfers to Project. No.	Value	Depreciation Amount	Sales of Used T&P Losses written off Transfers from Project. No.	Value	Closing Balance No. (2+3) - (4+5)	Value
1	2		3		4	5		6	
Cranes									
Dozers									
Dumpers Etc.									

Note: The principle use of this proforma will be to watch disposal of used-T&P towards the closing stage of the project and supplement the scrutiny through proforma (3)

Proforma (5)

Work Charged Man Hours

Category of work-charged employees	No. of Employees on first day of the budget period		No. of Employees on the last day Budget period		Man Hours available during Budgeted period		Allocation of Man Hours (or Number of Men) to various Major items of work or Division works		Output of work. in Vol/ In Money value.		Broad review of significant variation and reason.
	Budgeted	Actual	Budg.	Actual	Budg.	Actual	Budg.	Actual	Budg.	Actual	
1	2		3		4		5		6		7
a) Supervisors							1. Buildings 2. Plantation 3. Maintenance 4. Dam 5. Tunnel etc.				
b) Non Supervisors											

Note:- 1) The Principal object of this proforma is to pursue planning and execution of programme for building up of additional strength of workcharged employees as well as the phased retrenchment commensurate with works programme and also to watch deployment of the man hours in different sectors of the project. A supplementary proforma on monthly strength of workcharged employees may also be used.

2) Wages column and column on retrenchment benefit etc., budgeted and actuals have been omitted. These may be adopted where necessary.

It has to be kept in mind the cost control is to be excercised through recruitment and retrenchment policies, wage policies, and effective utilisation of man hours. Budgeted and actual cost of man hours will be merely a reflection of these policies and performance.

3) The classification in Column (5) is illustrative, each organisation may follow its own classification.

Proforma (6)

Establishment Cost

Category of Employee	No. of Officers and staff on the first day of Budget period		No. of Officers and staff on the last day of the budget period		Establishment Cost during budget period		Broad Review of Significant variations and reasons.
	Budgeted	Actual	Budgeted	Actual	Budgeted	Actual	
1	2		3		4		5
I) Officers							
a) General Manager							
b) Chief Engineer & Equivalent							
c) Superintending Engineer and Equivalent.							
d) Executive Engineer and equivalent							
e) Others.							
II) Staff							
a) Supervisors							
b) Non Supervisors (Other than peons etc.)							
c) Peons, Daftries etc.							

Note: The notes in proforma (5) apply mutatis mutandis to this proforma. However, unlike proforma (5) the proforma contains a column for the cost of establishment.

Proforma (7)

Budgeted Activities

Budget Items	Provision in the		Cumulative Expenditure upto end of the previous Budget period	Expenditure during budget period	Balance available Column(2) -(3+4b)	a) Date of Commencement b) Target date for completion i) Original ii) Latest revised date of completion iii) Forecast date of completion	Brief details of the important items of work as per latest forecast e.g. Earthwork concrete etc., the volume of quantity under each important work as per the present forecast. (For the entire programme from commencement to completion)
	Original Estimate	Latest Revised Estimate.		Budgeted Actual			
1	2		3	4	5	6	7
1) Preliminary							
2) Land							
3) Works							
i) Headworks							
Dams/Barrages							

1	2	3	4	5	6	7
4)Earthwork						
i) Main Canal & Branches						
ii) Distribution system						
5) Buildings						
6) Maintenance						
7) Miscellaneous						
8) Plantation						
9) Special Tools & Plants						
10) Losses on Stock						
11) Establishment						
12) Tools & Plant						
13) Suspense						
14) Receipts and Recoveries on Capital A/C.						

Progress in % with reference to latest project estimate.		Progress in % during the period under report.		Progress in % to the end of period.	Balance over the latest forecast.	Forecast of variation Physical variation in %	Financial variation representing the latest estimated cost.	Reasons for variations.	Critical factor which are likely to delay the completion of the balance work.
Target till end of previous year in %	Actual achievement to end of previous year %	Targeted	Actual						
8	9	10		11	(a)	12	(b)	13	14

Note: 1) In column (5) the balance of funds available will be figure in column (2) minus the sum of figures in column (3) and column (4) actual. The details of balance work as per the latest forecast will be under column (7) irrespective of the fact whether the latest forecast has or not been included in the latest revised estimate.

2) Increase in the scope of the work, increase in quantity and new works not envisaged in the original/latest revised estimate may be indicated with asterisks in Column (7) and Column (11).

3) Special reference should be made to those factors which will directly delay the out flow of the benefits from the project.

4) The activities to be reported upon under the Dams/Barrages could be a) Earth/Rockfill (b) Masonry/Concrete (c) Over flow section(d) Non flow section (e) Gates. The percentage of the progress of those would present a better picture of the stage of completion of project.

Annexure-XI

SPECIMEN OF COST CODE NUMBERS

(Refer Para 9.21 of the Chapter)

120-153 WORKS 'C'

Cost Account No.	Head of Classification
120.	Diversion Works.
121.	Preparation of foundation.
121.1	Dam.
121.2	Power Plant & Appurtenant Works.
122.	Earth Dam.
123.	Outlet Works.
124.	Spillway.
125.	Power Penstocks and Gates.
126.	Power Plant Structure and Appurtenant Works.
127.	Road to Power House.
128.	Job facilities.
129.	Muck & Haul Roads.
130.	Transmission & Distribution System for construction.
131.	Plant Structure erection & dismantling.

C - Works 120 - Diversion Works

Sub A/c No.	Quantity	Unit	Name of Item	Rate	Cost in Rs.
1	2	3	4	5	6
120.11		120.1	Excavation and clearing of Area:		
			Clearing and grubbing of work area.		
120.12	(Blank)				
120.13			Excavation of Talus & Rock in open cut.		
		120.2	Coffer Dam, Dewatering of work area and Diversion of Khad:		
120.21			Construction and removal of temporary Coffer Dams.		
120.22			Pumping & dewatering in all work areas including main dam and foundation tunnels and Power House.		
120.23			Diversion of Khad.		
		120.3	Diversion Tunnels.		
120.31			Excavation of rock in the diversion tunnels including steel supports and lagging.		

(Refer Para 0.30 of the Chapter)

Booking of Expenditure on Labour in Beas Project

1. The record of daily attendance of the workmen employed against a work is kept in TK Form-10 known as Foreman Time Card. This printed card contains columns for making attendance for 10 days at a time. On the last working day of the period to which the card relates, it is to be signed by the SDO/Xen., before it is passed on to TK(Time-Keeping)office. At the top of this form, the name of the work against which the labour is employed is required to be specifically given.

2. Pay rolls are prepared by the TK office in form TK-13 on the basis of attendance marked in the Foreman Time Cards(TK-Form-10). Sheets of the pay rolls are numbered, initialled and stamped by the SDO(TK) and are kept separately for each Division.

3. Thereafter, pay rolls duly signed by the SDO Time Keeping are passed on to Accounts Officer (Time-Keeping Pre-check Section of FA&CAO's office) on 3rd of every month. After necessary checks in the Pre-check Section of FA&CAO's office, the expenditure on a work on account of wages of workmen is posted in form TK-14 (Labour Distribution Summary, separately for each work). The summary sheets are then totalled up and checked/ signed by the Accountant. The main purpose of this form is to segregate the expenditure workwise. Thereafter, the monthly reconciliation statement is to reconcile the expenditure, segregated workwise in the Labour Distribution Summary (TK-14) with the grand total of pay roll.

4. After finishing with the pay rolls/reconciliation statement/Labour Distribution Summaries, A.T.E.O.(Transfer Entry Order) in TK Pre-check Section is prepared for each Division. Through this TEO, the expenditure is debited to work shown in the Labour Distribution Summary (TK-14) by contra credit to Sub-head P.W. Deposit. These TEOs alongwith pay rolls are put up to AO (Time Keeping) for pass orders. After the pay rolls are passed and TEO signed by the A.O., pay rolls are returned to SDO Time Keeping (Payment) for payment to the workmen and similarly, TEO alongwith Labour Distribution Summaries (TK-14) are passed on to TK Accounts Office for entering the TEOs in the adjustment book. The adjustment book is abstracted monthly.

5. After the payments are made, the paid vouchers/ rolls are entered in the cash book under the supervision of SDO Payment (TK). At the end of the month, the cash book is passed on to TK Accounts Section for scrutiny and abstracting the figures of receipt/payments and segregate the same under proper heads of account. The figures of expenditure as abstracted in the adjustment book and cash book are accounted for in form BPA-23 under the proper head of account against the concerned Division.

6. The expenditure on account of labour is generally booked through cash and adjustment. After finishing with the pay roll/reconciliation statement/Labour Distribution Summaries, a TEO is prepared in TK form-14 in pre-check Section for each Division. Through this TEO expenditure is debited to work shown in the Labour Distribution Summaries (TK-14) and contra credit is given to sub-head P.W.Deposit.

7. The Labour Distribution Summaries are passed on to the concerned Works Sections who deal with the accounts of a particular division.Figures of expenditure on account of labour charges as are shown in the LDS are entered in the Works Abstract which shows information in respect of other subheads of the work also.

TABLE:I Annexure XIII
(See Chart:I for NETWORKS)

REPORTING PROPORMA
FIRST YEARS

TOTAL BUDGET

Activity	Total Time Regd. (months)	Total Budget Amount (Rs. in lakhs)	BUDGET		ACTUALS	
			Performance % completion	Amount (Rs. in Lkahs)	Performance % Completion	Amount (Rs. in Lakhs)
1	2	3	4	5	6	7
1-2	3	Rs. 2	100.00%	Rs. 2.00	100%	Rs. 1.50
2-3	11	Rs. 7	81.82%	Rs. 5.73	50%	Rs. 6.00 Cols
3-4	5	Rs. 3	-	-	-	- 8 to
4-5	11	Rs. 8	-	-	-	- 15 on
2-4	15	Rs.12	60.00%	Rs. 7.20	20%	Rs. 4.00 next
2-5	16	Rs.13	-	-	-	- page
3-5	15	Rs.12	-	-	-	-
Total	30*	Rs.57		Rs.14.93		Rs.11.50

Rs.57 =26.19 - Rs. 57 = 20.18%
(Budget performance)

Note: * Times for critical activities are bracketed
** Variance for individual activities shall also be analysed into.
- material variance, sub classified into price variance, mix variance, yield variance
- labour variance, sub classified into rate variance, mix variance, efficiency variance.
- Overhead variances may also be classified.

TABLE: I
(See Chart : I for NETWORKS) Annex XIII

REPORTING PROFORMA

Activity	Budget expenses proportional to actual performances (Rs. in lakhs)	VARIANCES * Actual minus Budget corresponding to actual performances (Rs. in lakhs)		Actual minus year's Budget (Rs. in lakhs)		SECOND YEAR'S BUDGET (Without Revisions)		
		Adverse	Favourable	Adverse	Favourable	Further Total time required months	Performance % completion (from updated network)	Amount (Rs. in Lakhs)
1	8	9	10	11	12	13	14	15
1-2	Rs. 2.00	-	Rs. 0.50	-	Rs. 0.50	0	-	-
2-3	Rs. 3.50	Rs. 2.50	-	Rs. 0.27	-	5.5	50%	Rs.3.50
3-4	-	-	-	-	-	5	100%	Rs.3.00
4-5	-	-	-	-	-	11	-	-
2-4	Rs. 2.40	Rs. 1.60	-	-	Rs. 3.20	12	80%	Rs.9.60
2-5	-	-		-	-	16	32%	Rs.4.16
3-5	-	-	-	-	-	15	40%	Rs.4.80
TOTAL	Rs. 7.90	Rs. 4.10	Rs. 0.50	Rs. 0.27	Rs. 3.70	23*		Rs.25.06

Rs. 57 = 13.86% (Actual Performance)

Rs. 3.60 (Adverse)

Rs. 3.43(-underspent)

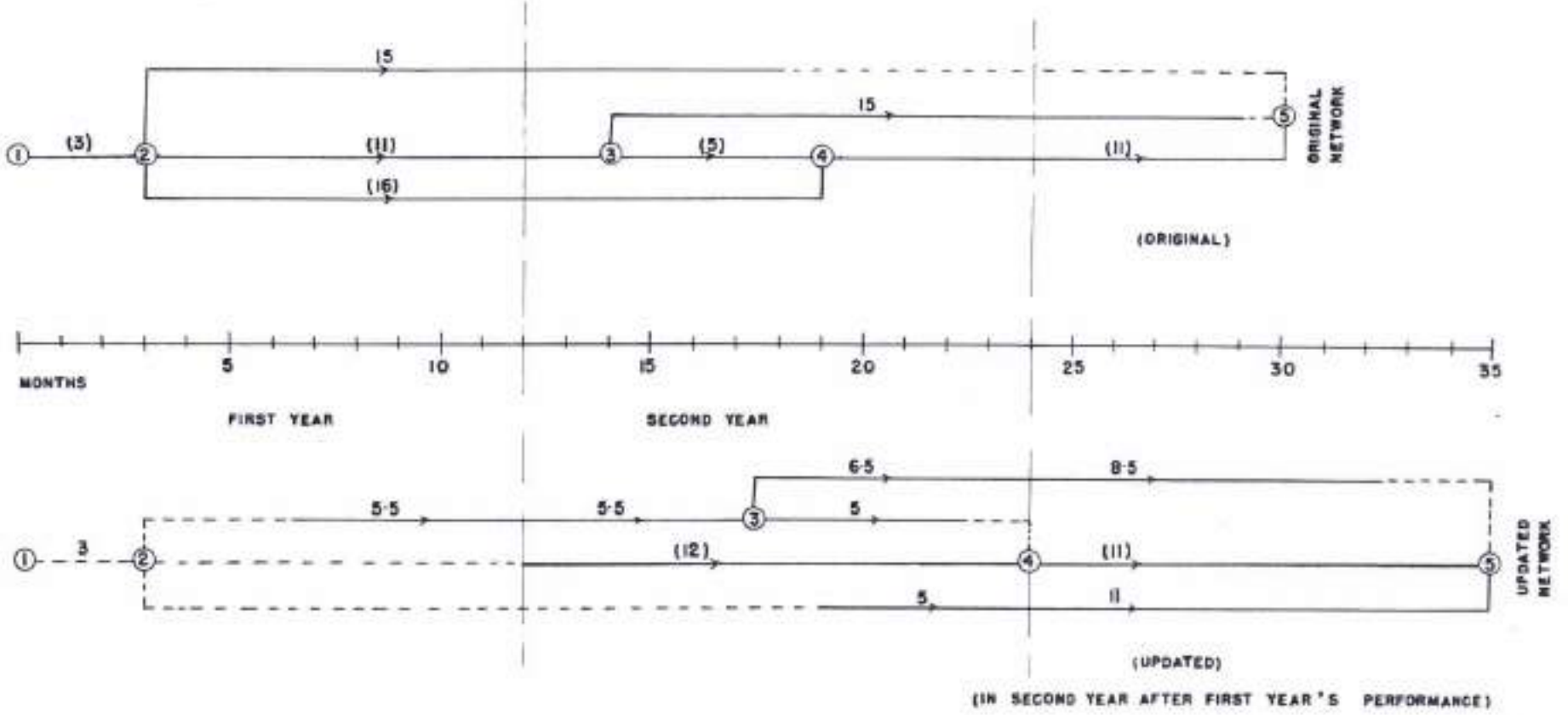
----------months from Second Year

Rs.57 = 43.96% (Budget performance)

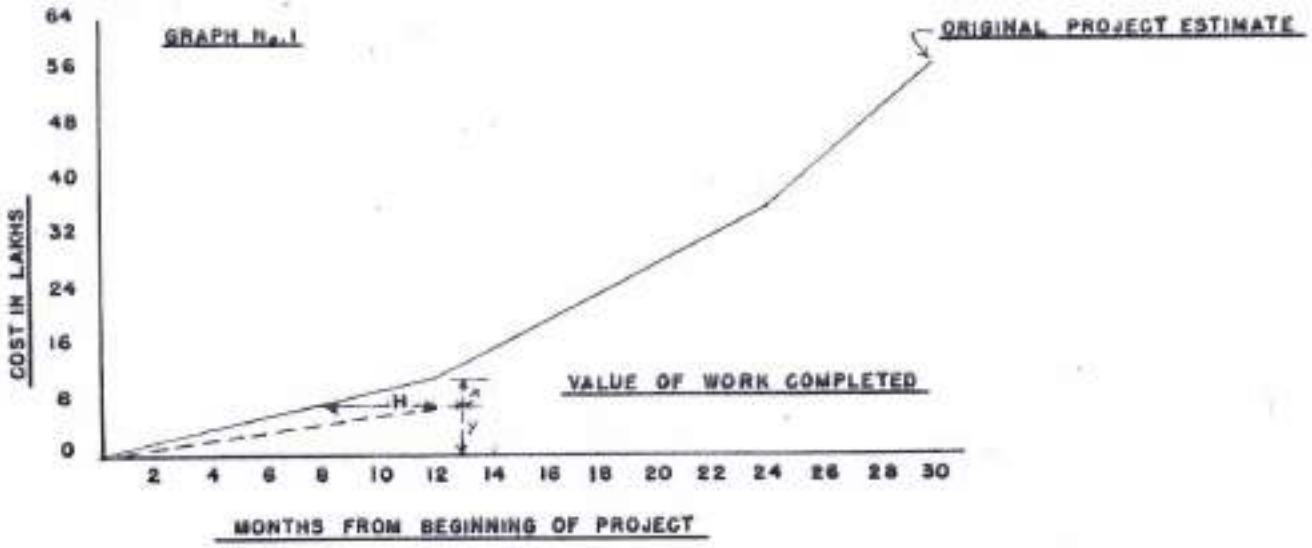
CHART I

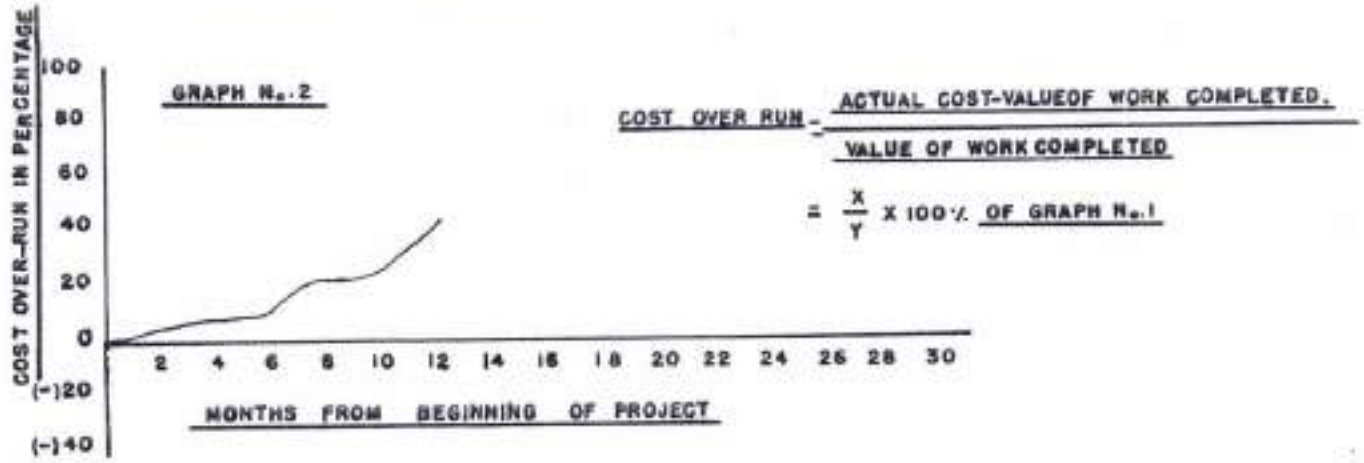
TIME - SCALE VERSION OF NETWORK.

(SEE TABLE I FOR DETAILS OF ACTIVITIES)



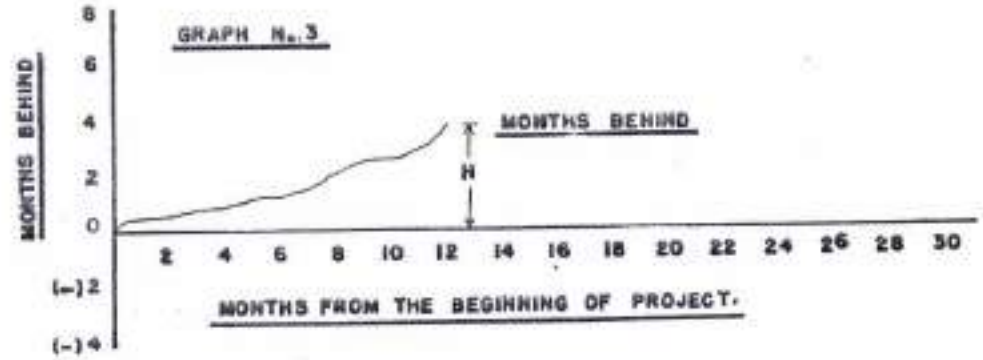
(IN SECOND YEAR AFTER FIRST YEAR'S PERFORMANCE)





$$\text{COST OVER RUN} = \frac{\text{ACTUAL COST - VALUE OF WORK COMPLETED.}}{\text{VALUE OF WORK COMPLETED}}$$

$$= \frac{X}{Y} \times 100\% \text{ OF GRAPH No.1}$$



TIME & MOTION STUDIES - OUTPUT OF SHOVELS/DRAGLINES

Size of Shovel/ Dragline M^3	Average cycle time (Secs.)	Observed hourly production (loose) M^3	Angle of swing	Depth of cut (M)	MATERIAL	Ideal hourly production as per P.C.S.A* Bank cu.m.	FACTORS FOR Depth of cut & angle of swing	FACTORS FOR Job & Management	Percentage of swell	Expected hourly production Bank M^3	Expected hourly production Loose M^3	Ratio observed expected Production
1	2	3	4	5	6	7	8	9	10	11	12	13
		SHOVELS										
2.3	30.5	231.6	135^0	6.0	Silty clay	360	0.71	0.75	23%	191.7	235.79	98.22
2.3	30.61	168.1	60-90^0	4.8	Silty clay	360	0.90	0.75	23%	243.0	298.89	56.24
2.3	19.8	427.6	60-90^0	6.8	Silty clay	360	0.90	0.75	23%	243.0	298.89	143.06
1.9	25.90	199.18	90^0	2.82	Semi pervious	298	0.98	0.75	20%	219.03	262.83	75.78
1.9	27.96	114.17	90^0	2.0	River Bed Material (Sand & Boulders	298	0.98	0.75	14%	219.03	249.69	45.72
1.9	29.1	196.33	90^0	2.0	-do-	298	0.98	0.75	14%	219.03	249.69	78.62
1.9	24.7	260.9	$45^0$to 135^0 -90^0 AV.	7.5	Semi-pervious	298	0.85	0.75	20%	189.97	227.97	114.44
1.9	21.5	288.8	$45^0$to 135^0 -90^0 AV.	7.5	Semi pervious	298	0.85	0.75	20%	189.97	227.97	126.68
1.9	21.2	239.3		7.5	Semi pervious	298	0.85	0.75	20%	189.97	227.97	104.96
1.9	25.0	242.0	$45^0$to	6.5	Semi pervious	298	0.9	0.75	20%	201.15	241.38	100.25
1.9	25.0	271.0	110	6.5	Semi pervious	298	0.9	0.75	20%	201.15	241.38	112.27
1.9	27.35	231.91	-75^0 AV.	6.5	Semi pervious	298	0.9	0.75	20%	201.15	241.38	96.07
1.6	37.69	205.78	180^0	3.0	Clay Wet(sticky)	375	0.62	0.75	35%	174.375	235.40	87.41
4.6	37.3	363.7	90^0	10.6	Silty clay	608	0.85	0.75	23%	387.6	476.75	76.28
		DRAGLINE										
1.9	51.0	129.6	180^0	2.82	Hard strata with boulders	175	0.75	0.75	25%	98.4	123.00	105.36
1.9	36.49	150.9	90^0 - 135^0	2.82	Silty clay	235	0.90	0.75	23%	158.62	195.10	77.34
											Average	93.66

*P.C.S.A.-Power Crane & Shovel Association.
The figures of hourly production are for 60 Mt. Hour.

ANNEXURE-XV

NATIONAL THERMAL POWER CORPORATION LTD.
RAMAGUNDAM SUPER THERMAL POWER PROJECT.
REVISED ESTIMATE 1980-81
DIRECT CAPITAL OUTLAY

Form No.8-3
Sheet No._____of_____

Work head No. & Budget head No.	Units	Budget Estimate	Actuals April to August	Anticipated 1st September to 31st March							Total (5 to 11)	Revised Estimate (4+12)	Excess(+) S.fall(-) (13-3)
				Sept.	Oct	Nov.	Dec.	Jan.	Feb.	Mar.			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
16 Water Cooling System													
16.4 Reservoir & Dam													
Earth work	Lac M^3	44000 (22)		810 (0.40)	3600 (1.60)	5340 (3.40)	5340 (3.40)	5300 (3.05)	4850 (3.00)	5010 (3.00)	30250 (17.85)		
Aggregate & Rip-rap	M^3	7500 (150000)			200 (9000)	500 (18000)	1900 (54000)	2300 (63000)	2300 (63000)	2300 (63000)	9500 (270000)		
		51500	2442	810	3800	5840	7240	7600	7150	7310	39750	42192	(-) 9308
16.4.2 Spilling out & outlet works.		7520 (IA)	520	400	1077 (EA)	777	1041	1147	1031	728	6193	6713	(-) 807
Excavation 2.25Lac M^3				(0.30)	(0.37)	(0.37) (1000)	(0.43) (1500)	(0.43) (1500)	(0.35) (1500)	(2700)	(2.25) (8200)		
Masonary(65900 M^3 M^3)													
Concreting(10600 M^3)								(200)	(400)	(400)	(1000)		
CW System Power Canal 55 lacs.		1500							500	500	1000	1000	(-) 500
CW System-gates.		500											(-) 500
Remodelling of D-83 & L 12 canals by AP Government.		10000						5000		5000	10000	10000	
Total 16.4.2		19520	520	400	1077	777	1041	6147	5131	6220	17193	17713	(-) 1807
TOTAL 16.4.2.		71020	2962	1210	4877	6617	8281	13747	8681	13530	56943	59905	(-)11115

NATIONAL THERMAL POWER CORPORATION LTD.
RAMAGUNDAM SUPER THERMAL POWER PROJECT .
REVISED ESTIMATE 1980-81
DETAILS OF CONSTRUCTION EQUIPMENT

Form No.B-3

Minor head No.	Units	Budget Estimate	Actuals April to August	Anticipated 1st Sept. to 31st March						Total	Revised Estimate	Excess(+) S.fall(-)
				Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Tippers	2 Nos.	350										-	(-) 350
2. Heavy Trailor(20/25T)	2 Nos.	160										-	(-) 160
3. Elec. Welding Transformer	12 Nos.	96											
4. Gascutting Sets	12 "	24	11			100				89	189	200	(-) 80
5. Pumpsets	3 "	160										-	(-) 60
6. Survey instruments	LS	60								296	296	296	(+) 96
7. Spares for Constn. Equipment	LS	200										165	(+) 65
8. Workshop Machinery incl. Spares & Tools	LS	100	165									-	(-)2100
9. Gantry Crane	1 No.	2100										-	(-)1800
10. Tower Crane	1 No.	1800										-	(-) 100
11. Automatic Telephone Exchange	1 Set	100										-	(-) 120
12. Lab Equipment	LS	120										13	(-) 787
13 Elec. Equipment	LS	800	13									31	(-) 369
14. Firefighting Equipment	LS	400	31									-	(-) 300
15. Pneumatic Gunniting Machine	1 No.	300										-	(-) 60
16. Misc. Const. Equipment	LS	60											

RAMAGUNDAM SUPER THERMAL POWER PROJECT
REVISES ESTIMATES 1980-81
CONSTRUCTION STORES & MATERIALS

Sl. No.	Particulars	Structural Steel		Reinforcement Steel		Cement		Others	Total	Remarks
		Tonnes	Amount Rs./000	Tonnes	Amount Rs./000	Tonnes	Amount Rs./000	Amount Rs./000	Amount Rs./000	
1	2	3	4	5	6	7	8	9	10	11
1.	Opening balance as on 1-4-1980.	19745	61577	13658	42599	2935	1518	3777	109471	
1.A.	Advances to Suppliers Materials in Transit(C)							35489	35489	
2.	Purchases (1980-81)	4000	12800	8500	24650	25000	12500	10000	59950	
3.	Total Col.1 + Col.2)	23745	74377	22158	67249	27935	14018	49266	204910	
4.	Consumption (1980-81)	4543	14229	2280	6920	15142	7602	7567	36318	
5.	Closing balance as on 31-3-1981(Col.3-Col.4)	19202	60148	19878	60329	12793	6416	41699	168592	
5.B.	Deduct closing balance of advance as per (C)									
6.	Accretion(+)/Decretion(-) (Col.5 - Col.1)	(-)543	(-) 1429	(-) 18220	17730	9858	4898	2433	23632	

NATIONAL THERMAL POWER CORPORATION LTD.
RAMAGUNDAM SUPER THERMAL POWER PROJECT.
WORKWISE BREAK UP OF CONSUMPTION
1980-81

Form No.B-8

Work Head No.		Structural Steel		Reinforcement Steel		Cement		Others	Total	Re-marks
		Tonnes	Amount Rs./000	Tonnes	Amount Rs./000	Tonnes	Amount Rs./000	Amount Rs./000	Amount Rs./000	
2		3	4	5	6	7	8	9	10	
Roads, Bridges, Culverts	2.3	150	470	50	151	400	201	2500	3322	
Auxiliary Buildings	3.4	8	25	4	12	10	5		42	
Main Plant Foundations	5	130	407	1015	3081	5776	2000		6388	
Temporary Township	3	30	94	525	1593	3000	1506	5067	8260	CI Pipe RCC Pipe
Structural Steel	4	4190	13123	-	-	128	64		13187	
C.W. System - Part-I	16.2	35	110	440	1336	2100	1054		2500	
C.W. System Part - II (Earth Dam)	16.4					128	64		64	
Masonry Dam	16.4			200	607	2000	1004		1611	
Boundary Wall				46	140	1600	804		944	
Total		4543	14229	2280	6920	15142	7602	7567	36318	

NATIONAL THERMAL POWER CORPORATION LTD.
RAMAGUNDAM SUPER THERMAL POWER PROJECT.

REVISED ESTIMATES & BUDGET ESTIMATES
BUDGET FOR EMPLOYEE COST

Rs.'000
Form No. B-9
Sheet No. Of

Actual upto & of pre-vious year	Budget Head		Budget Esti-mate	Actual April to Aug.80	Revised Estimate 1980-81 Sept. 80	Oct. '80 to Dec. '80	Jan.'81 to March 1981	Total of Col. 4 to 7	Budget Estimate 1981-82 April '81 to June 1981	July to Sept. 1981	Oct. '81-Dec. 1981	Jan. 1982-March 1982	Total 9 to 12	Total of the Year Cols.13+Cols. 7 to 4 + Escalation.
1	2		3	4	5	6	7	8	9	10	11	12	13	14
	Salaries & Wages	Basic	577	146	576	817	2116	859	697	449	211	2216	5486 (3% escalation)	98
	D.A.		201	53	212	308	774	310	255	171	69	805	2036 (10% escalation)	204
	Total		778	199	788	1125	2890	1169	952	620	280	3021	7824	
	M.P.A.		3	1	2	3	9	4	5	3	2	14	22	
	C.C.A.		-	-	-	-	-	-	-	-	-	-	-	
	H.R.A.		3	1	9	33	46	86	70	45	21	222	354	
	Project Allowance		69	18	72	106	265	113	92	62	25	292	717	
	Total		853	219	871	1267	3210	1372	1119	730	328	3549	8917	
	Contribution to PF		121	17	66	94	298	97	79	53	23	251	627	
	Gratuity		32	8	33	47	120	49	40	26	12	127	313	
	Foreign Service		10	2	7	7	26	18	7	7	8	30	57	
	LTC		2	20	30	29	81	75	75	75	75	300	300	
	Leave Encashment		8	5	50	53	116	80	80	80	35	275	275	
	Welfare & Safety		116	30	150	120	416	150	150	150	150	600	600	
	Medical		31	8	32	41	112	62	63	62	60	247	247	
	Other (conveyance)		6	2	9	10	27	11	13	16	17	57	57	
	Daily Rates		91	19	57	57	224	60	60	60	60	240	240	
	Total		1270	330	1305	1725	4630	1964	1686	1358	768	5676	11633	

MANPOWER SUMMARY FOR 1980-81

Form No. 8-9A

Grade	As on 31.8.80 (Budget)	As on 31.3.81 (Proposed)	Additional Manpower				Remarks
			Sept. 80	Oct. to Dec. 80	Jan. to March 81	Total	
1	2	3	4	5	6	7	8
Executives							
E8	1	1	-	-	-	-	
E7	1	1	-	-	-	-	
E6	2	2	-	-	-	-	
E5	4	6	-	1	1	2	
E4	10	11	-	1	-	1	
E3	14	22	1	5	2	8	
E2	21	31	-	-	10	10	
E1	1	1	-	-	-	-	
Total	54	75	1	7	13	21	

MANPOWER SUMMARY FOR 1980-81

Form No. B-99

Grade	As on 31.8.80 (Budget)	As on 31.3.81 (Proposed)	Additional Manpower				
			Sept.80	Oct. to Dec. 80	Jan.81 to March 81	Total	Remarks
1	2	3	4	5	6	7	8
Non-Executives							
Supervisors (Technical)	33	60	4	7	16	27	
Supervisors (Non-Tech.)	14	29	-	7	8	15	
Non-Supervisors(Technical)	72	199	5	37	85	127	
Non-Supervisors (Non-Technical)	29	74	3	20	22	45	
Total	148	362	12	71	131	214	

Grand Total 148 + 214 = 362

Annexure-XVI

PERFORMANCE BUDGET PROFORMA
NATIONAL HYDROELECTRIC POWER CORPORATION LTD.

3. WATER CONDUIT SYSTEM — LOKTAK

Latest estimated Cost 4077.94
Expenditure upto 31.3.79 2671.59
Balance as on 31.3.79 1406.35

(Rs. in Lakhs)

Sl.No. of Project Estimate	Head of Accounts	Item of Work	Unit	As per Project Estimate		Expenditure upto 31.3.79.		Budget Estimate 1979-80		Revised Estimate 1979-80		Budget Estimate 1980-81	
				Qty./ Rate	Amount	Qty./ Rate	Amount	Qty./ Rate	Amount	Qty./ Rate	Amount	Qty./ Rate	Amount
1	2	3	4	5	6	7	8	9	10	11	12	13	14
		(A) Power Channel (Cost 1482.13) (Expenditure upto 31.3.79 - 1182.46)											
1.	0201-08	Earth work excavation in all kinds of soils disposal beyond the working area for all lead & lifts including cost of dewatering.	M^3	3011100 / 18.00	541.99	2613617 / 17.10	446.93		-		5.98		
3.	0201-08	Dry boulder pitching on the side slopes with all leads & lifts.	M^3	29036 / 110	31.94	29490 / 104.50	30.82		-	1220 / 105	1.28		
16.	0201-08	R.C.C. M-150-Preparation of surface, shuttering laying cement as per specifications.	M^3	420 / 390	1.64	810 / 351.50	2.85	-	-	1042 / 358	3.66		
17.	0201-08	R.C.C. 1-200	M^3	15157	65.93	9338 / 605	56.49	1200 / 605	7.26	2300 / 605	13.92		
18.	0201-08	Steel reinforcement for R.C.C. works.	MT	2872 / 1980	56.87	1170 / 1984	23.23	150 / 2300	3.45	50 / 1948	0.99		
19.	0201-08	Providing & laying shingle of grade 5 to 20mm in bed and side slopes.	M^3	28695 / 105.25	30.20	27726 / 105.25	29.18	-	-	4100 / 105	4.32		
20.		R/R masonry with hard stone in foundation and plinth with C.M. 1:6	M^3	7705 / 160	12.33	8569 / 154	13.20	-	-	700 / 150	1.02		
24.	0201-08	Providing & laying cc(1:5:10) including cost of centering and shuttering in foundation.	M^3	1455 / 273	3.97	2461 / 269.75	6.64	-	-	550 / 270	1.48		
25.	0201-08	Back filling with appropriate soil upto original ground level including watering etc.	M^3	98136 / 17.00	16.68	36430 / 17	6.19	5000 / 17	0.85	4000 / 17	0.68		

6. MACHINERY & EQUIPMENT

Latest Estimated Cost 516.17
Expenditure upto 31.3.79. 483.88
Balance

LOKTAK

(Rs. in lakhs)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
	0201-14	Cost of PIP Cables for alpine Minor and other PCP Equipment.							10.00		14.50		2.50
		Purchase of automatic gas							0.30		-		-
		Purchase of compressors and workshop Electrical & mechanical equipments.							4.00		10.50		2.50
		Purchase of Mine cars & haulage equipment							5.00		5.00		3.00
		Purchase of FLP Locomotives Nos. and spares.	11						30.00		32.00		20.00
		Purchase of Alpine Miner No.	2						60.00		65.00		15.00
		Purchase of FLP blowers							2.30		4.30		2.50
		Pumping Plants for F/o, F/4 & F/5							2.00		3.00		2.00
		Vehicles							2.50		2.50		2.00
		Generating Plant & Machinery for D.P.H.							4.00		4.00		-
		Miscellaneous items							3.00		3.50		5.00
		Winder for Face-D.							-		4.40		-
		Purchase of shotcreting machines									4.00		6.00
		Concrete pumps with accessories and spares										-	60.00
		Equipments taken over from P.K.C.									10.00	-	-
		Front end Loaders									3.40		

11. SUSPENSE

REVISED ESTIMATE 1979-80

(Rs. in lakhs)

STORE SUSPENSE

Debit (+) Cost of materials to be procured	Amount	Credit (-) Adjustment of materials issued to contractors and works	Amount
Purchases:		Issues:	
i) Cement : 8000 M.T. @ Rs. 450/- M.T.	36.00	i) Cement : 8500 M.T. @ Rs. 700/- M.T.	59.50
ii) Steel : 1600 M.T. @ Rs. 3000/- M.T.	48.00	ii) Steel : 2500 M.T. @ Rs. 3500/- M.T.	87.50
iii) P.O.L.	65.00	iii) P.O.L.	65.00
iv) Spare for D.P.H.	35.00	iv) Spares for D.P.H.	15.00
v) Other spares	30.00	v) Other spares	40.00
vi) Freight charges	30.00	vi) C.G.I. sheets	9.40
vii) Others	10.00	vii) Others	15.00
TOTAL (+)	254.00	TOTAL	(-) 291.40

(-) 291.40

(+) 254.00

NET (-) 37.00

11. SUSPENSE

BUDGET ESTIMATES 1980-81

(Rs. in lakhs)

Debit (+)

STORE SUSPENSE

Credit (-)

Cost of materials to be procured	Amount	Adjustment of materials issued to the contractors and works	Amount
Purchases:		Issues:	
i) Cement : 8000 M.T. @ Rs. 450/- M.T.	36.00	i) Cement 7000 M.T. @ Rs. 700/- M.T.	49.00
ii) Steel : 1200 M.T. @ Rs. 3000/- M.T.	36.00	ii) Steel : 1500 M.T. @ Rs. 3500/- M.T.	52.50
iii) P.O.L.	70.00	iii) P.O.L.	70.00
iv) Spares for D.P.H.	5.00	iv) Spare for D.P.H.	15.00
v) Other spares	20.00	v) Other spares	25.00
vi) Freight charges	25.00	vi) Others	10.00
vii) Others	10.00		
TOTAL (+)	202.00	TOTAL (-)	221.50

	(-)	221.50
	(+)	202.00
NET	(-)	19.50

ANNEX. XVII

COMMITTEE ON COST CONTROL
OF RIVER VALLEY PROJECTS
QUESTIONNAIRE

C O N T E N T S

Item No.	Subject	Reference to Annexure
1.	Exploitation of labour resources	I
2.	Norms for specifications and Format for rate analysis for Water Development Projects	II
3.	Modern system & techniques of material management & Inventory Control	III
4.	Cost Control Cells	IV
5.	Performance & Outputs of Indigenously manufactured/imported earthmoving machinery	V
-	Copy of letter No.1/4/77-R&C dated 20.4.77	VI
-	Copy of O.M. No.17/26/76-MFE dated 25.2.77 regd. setting up the Committee	VII
-	Note on Performance Budgeting	VIII
-	Brief Note on Evolution of Labour Norms ..	IX

ITEM NO. 1: EXPLOITATION OF LABOUR RESOURCES

1. One of the term of reference of the Committee is to study and suggest measures for exploitation to the fullest extent of the labour resources available in the country on a continuing basis on water development projects with due consideration to the changed context in the construction work and increased degree of mechanisation necessary presently and in times to come. Please indicate your views and suggestions on this aspect.

2. Keeping in view the constraints on public investment expenditure and also the target fixed for achievement how an effort to promote more labour intensive construction of river valley projects can be made to produce significant increase in the share of employment by way of (a) Selection of the project, (b) Choice of technology and (c) Designs.

3. Please indicate, what in your opinion, are the items of work that can be handled economically and effectively by manual labour consistent with the targets set for the completion of projects. Kindly indicate your reasons.

4. Please indicate the component of labour and equipment (in terms of financial outlay) for the following works of the projects in the State. The information may be furnished projectwise:-

i) Head works (Dam, barrage, weir)
ii) Tunnels
iii) Main Canal
iv) Power House
v) Other important works (if any)

The figures may be given for the past 2-3 years. Please indicate the agency employed for each of the works. Please add a small descriptive note indicating the type of work and the cost.

5. Please indicate separately the numbers and the cost components of skilled and unskilled labourers for the following works of the projects under construction in the States:-

i) Head works (Dam, barrage, weir)
ii) Tunnels

iii) Power House
iv) Main Canal
v) Other important works (if any)

Please give a brief descriptive note and also information for as many working seasons as possible.

6. Please indicate the labour potential available on a statewise and districtwise basis. Please indicate skill-wise classification, if available. Please indicate information on the seasonal availability of labour.

7. Please indicate the source from which labour is being obtained in the project under construction.

8. Please indicate whether programme for continuing employment to labour has been formulated. If so, give details.

9. Indicate if a comprehensive Master Plan of water resources development has been formulated by the State. If so, give details. Also please attach copies of Master Plans, drawings etc.

10. Please give your views on the adequacy of the available labour potential to carry out the water resources development plan in your State.

11. Please indicate if you have observed any difficulty in the execution of labour intensive projects departmentally/through piece workers/through contractors, if so, brief details may be given.

12. When certain works on the projects are such where labour intensive methods could be employed with advantage, would you recommend to get the works executed departmentally or through piece workers or through contractors? Brief reasons for the choice may be given.

13. When certain works on the projects are such where capital (Machinery) intensive methods could be employed with advantage, would you recommend to get the works executed departmentally or through piece workers or through contractors? Brief reasons for the choice may be given.

14. Please supply the current schedule of rates in respect of wages of different categories of workers.

15. Taking into consideration the special nature of work in the river valley projects whether done through contract or employment of departmental labour and the fact that the works are in the interior where the necessary labour force has to be mustered from outside the area, there

is a little continuity of work after completion of the project etc. what modifications would you suggest in the existing labour laws to make them more effective, simultaneously ensuring the desired progress on works?

16. Please list out the labour laws that are followed on your project/in your State. If possible, supply copies.

17. What are the difficulties, if any, in implementing these labour laws?

18. Do the Projects in your State have labour unions, if so, give a list?

19. What are your reactions to payment of full wages/part wages in kind. What are the likely labourer's reaction to such proposal?

20. What is your estimate of the direct labour cost component in river valley projects during the Third and Fourth Five Year Plans with respect to major, medium and minor projects separately?

21. What are the amenities provided to the labourers on the projects?

ITEM NO. 2: NORMS FOR SPECIFICATIONS AND FORMAT FOR RATE ANALYSIS FOR WATER DEVELOPMENT PROJECTS

1. One of the term of reference of the Committee is to set down national norms for specifications and format for rate analysis for water development projects comprising:

a) Standard description of main items of universal nature in rationalised units.

b) Standard specifications in consonance with Indian Standards in order to remove the present inconsistencies which are very often exploited resulting in loss to Govt. These specifications should be clearly and unambigously worded to enable proper quality control.

c) Standard methods of measurement particularly for items like earthwork in embankments, boulder stacking and placement, overbreak in tunnelling etc.

d) Analysis of rates both for manual as well as machinery works based on standard constants of labour, material, tools and plant etc. in different zones of the country.

Please indicate your views and suggestions on this.

2. Please indicate the list of main/important items of universal nature which you would recommend for formulation of standard description.

3. Please indicate if specifications for the items referred to in '2' above have already been drawn up. If so, copies thereof may be supplied.

4. Indicate if standard specifications for various items for the State as a whole have been drawn up. If so, copies may be supplied.

5. Indicate if description of items have been standardised for your State/Project. If so, details may be furnished.

6. If I.S.I. Standard specifications are to be adopted in all contracts to ensure uniformity would there be any difficulties?

7. Please indicate your proposal for standard methods of measurement including units of measurement for important items.

8. Indicate if you have standard formats for carrying out analysis of rates. If so, copies may be supplied.

9. Please furnish details analysis/cost data, based on actual observations in respect of important items of works completed or under construction in your project. Some of the items are indicated below:-

a) Masonry in dams done departmentally/through piece worker.

b) Masonry in dams done through contract.

c) Concrete in dams done departmentally/through piece worker.

d) Concrete in dams done through contract.

e) Earthwork in dams done departmentally/through piece worker.

f) Earthwork in dams done through contract.

g) Large canal excavation done departmentally/through piece worker/through contract.

h) Canal lining done departmentally/through piece worker/ through contract.

i) Tunnelling in (i) Deccan trap/competent geology.
(ii) Himalayan region/metamorphic geology.

In case the above date is not available, it is requested that observations towards this may be carried out over a period of next few months (please refer letter No.1/4/77-R&C dated 20.4.1977, copy enclosed).

10. Have standard constants of labour, material, tools and plants etc. been laid down for different items of work done manually and also by machines, if so, please supply details. Are these standard constants based on actual field studies carried out adopting modern work management techniques?

ITEM NO.3: MODERN SYSTEM AND TECHNIQUES OF MATERIAL MANAGEMENT AND INVENTORY CONTROL

1. One of the term of reference of the Committee is to suggest measures for introduction of modern system and techniques of material management and inventory control, performance budgeting system adopting modern practices, resorting to computerisation, etc. Please indicate views and suggestions on this.

2. Describe the present system of material management with a brief idea of the organisational set up, the difficulties, if any, being experienced and the suggestions to overcome them. The note should cover the following points in particular:

(a) System of purchase:

i) Materials planning;

ii) Purchase initiation with delegation of power for different officers;

iii) Placing of purchase orders on the basis of tenders/ running contracts/otherwise;

iv) Arrangement for following up of pending supplies;

v) Arrangement for making emergency purchases with or without provision of funds;

vi) Difficulties experienced towards the procurement of imported items.

(b) System of receipts:

i) Method of verification of purchases with reference to the purchase order;

ii) Verification of quantity and quality of goods received.

(c) System of payments:

i) Are payments being made in advance fully or partly? If so, under what circumstances and under what authority?

ii) Whether the payments made are pre-audited? If so, what procedure is followed?

(d) System of store-keeping:

i) Arrangements for physical store keeping;

ii) Classification of stores and quantity records i.e. registers etc.;

iii) Periodical stock taking and the frequency and authority by whom done;

iv) Whether any slow moving, dorment, obsolete items are in the stores? If so, what are their value and age and what method is to be followed for dealing with them?

(e) System of issue:

i) Method of physical issues and forms used therefor;

ii) Method of evaluation of issues to contractors, works and others;

iii) Treatment of difference arising from valuation etc.

(f) System of accounting:

i) The procedure followed for material accounting when (a) advance payment is made and (b) when payment is made on receipt of materials.

ii) Accounting procedure followed for the adjustment of shortages and surpluses noticed during the course of physical verification of store or otherwise.

3. Is any centralised information available state-wise, project-wise, area-wise for the stock holdings and the stock requirements? If not, what arrangements are obtaining in your organisation for the speedy utilization of spare/surplus inventories.

4. Are you operating rate contracts finalised by D.G.S.& D? Have you encountered any difficulties in this regard?

5. What is the annual overall expenditure on the existing system of inventory control and what percentage does it bear to the total cost of the inventory held?

6. How do you achieve optimum inventory levels and reduce the expenses in maintaining surplus stocks while minimising, at the same time, the risk and frequency of stockouts?

7. What is the system available for locating purchases where are found defective during the course of actual use or otherwise; and how are such materials identified with the suppliers and disposed of?

8. Give details of the total purchases made during 1975-76 and 1976-77 indicating the number of items purchased as well as their value under the following heads:

i) Spare parts;

ii) Equipment.

Indicate separately if any individual items under the above heads exceed 10 per cent of the total value.

The information asked for in the preceding paragraph may be furnished in respect of materials consumed for the said two years. Also give closing stock as on 31st March, 1977.

9. Is it possible to furnish similar information in respect of other stores? If not have you come across any cases of over-stocking or stock-outs of any other materials required for river valley projects? What system do you follow to ensure that such over-stocking or stock-outs do not take place?

10. Indicate the relationship of value of inventory of spares, the total value of equipment and also the total value of work done during the respective years.

ITEM NO. 4: COST CONTROL CELLS

1. Indicate if Cost Control Cells have been established in the State/Project, if so, give details.

2. In case cost cells have not been established, the procedure followed for keeping control on the costs may be described.

3. Are the costs of projects evaluated periodically, if so, the frequency of evaluation may be stated.

4. Indicate the existing organisational pattern and the functions of the cells. Do you find any difficulty in operation of these cells, if so, what improvements would you suggest?

5. Indicate whether cost analysis is done separately for different components of a project or for the project as a whole. In the latter case, indicate the difficulties, if any, for which cost assessment of components cannot be carried out.

6. Indicate the various reports that are obtained from the executing authorities for purposes of cost analysis. Copies of the formats, as also copies of formats in which the information received is processed and analysed may also be given.

7. Is the revaluation of the cost of the work in progress done? What is the method followed?

8. What are the indirect charges that have been charged to the project/component cost? How are they presently being charged? How are they worked out? It is generally seen that indirect charges are decided as a certain percentage of cost of work. Do you find these percentages are adequate? Have you any modification to suggest on the basis of your experience? How frequently are the percentages of indirect charges revised? Kindly indicate the indirect charges on a few projects in your State.

9. Do you follow performance budgeting in addition to financial budgeting. Kindly give a brief note on the system followed. Kindly supply a copy of the performance budget of the projects in your State for the previous year. Do you find any difficulties in operating the

system? What are your suggestions to improve the system? (note on performance budgeting enclosed).

10. Is the performance budget for a project being prepared? Is it prepared for entire period during which the project is expected to be completed or is it prepared on year to year basis?

11. What is the annual expenditure on the cost control cells, if established in the State and what is its percentage to the works expenditure?

12. Is the expenditure taken into account for working out the cost of the project reconciled with the corresponding figures of expenditure appearing in the financial accounts? If so, does this reconciliation disclose any variations? In that case indicate the reasons therefor and the treatment of variations.

ITEM NO. 5: PERFORMANCE AND OUTPUTS OF INDIGENOUSLY MANUFACTURED/ IMPORTED EARTHMOVING MACHINERY

1. Indicate whether purchase of earthmoving equipment in your State is being done independently by the Projects or through a Central Pool?

2. Indicate whether you would suggest purchase of earthmoving equipment through a Central Pool.

3. Please furnish a list of indigenously manufactured earthmoving machinery on the various Projects in your State, in the proforma at Appendix 'A'.

4. Please furnish a list of imported earthmoving equipment on the various projects in your State in the proforma at Appendix 'A'.

5. Please indicate availability of the machines and if the availability is low indicate reasons. This may be given separately for indigenous and imported equipment. Information may be given only for the following equipment:

Shovels	-	Draglines, backhose
Tractors	-	Crawler, Rubber tyred.
Scrapers	-	(a) Drawn (b) Motorised.
Dumpers	-	(a) Rear (b) Bottom.
Loaders	-	(a) Crawler (b) Pneumatic tyred.
Hydraulic Excavators		
Motor Graders		

tage availability of equipment =

$$\frac{\text{Actual hours worked}}{\text{Schedule production hours depending on number of shifts*} \; (-) \; \text{hours idle for want of work}} \times 100$$

* for single shift = 1200 hrs.
for double shift = 2000 hrs.
for three shifts = 2500 hrs.

6. Indicate project-wise approximate annual output of earthwork carried out by earthmoving equipment on the major projects in your State in the past three years.

7. Indicate project-wise the equipment used for obtaining the output referred to in item 6 above and the working hours for which it was used during the years, in question.

8. Indicate the actual outputs realised in actual working for earthmoving equipment to enable laying down realistic norms. Please give details of type of soil, average haul cycle, average lift involved.

9. Indicate the unit rate of earthwork realised in each of the preceding three years on the major projects executed by using earthmoving equipment.

10. Indicate the method of assessment of unit rate of earthwork done by earthmoving machinery explaining in detail the calculations arrived at for plant hour rates.

11. Indicate the method of apportioning indirect and overhead charges to the cost of earthwork by machinery giving details of items included in arriving at total overhead/indirect costs.

12. Are time and motion studies carried out on the projects where earthmoving machinery is being used? If so, give details with norms adopted.

13. Indicate the difficulties, if any, experienced in obtaining spare parts (rate contract/non-rate contract) for indigenous/imported machinery. Suggestions to overcome the difficulties may also be given.

14. Indicate if a problem of non-genuine spare parts has been experienced. Suggestions to avoid recurrence of such problems may also be given.

15. Do you find any difficulties in the after sales service of indigenous/imported earthmoving equipment? What are your suggestions in improving the after sale service?

Appendix 'A'

CENSUS OF EARTHMOVING MACHINES (Items 3 & 4 of the Questionnaire)

Name of Project/Unit_____ State_____

Category of Machine_____

Sl. No.	Description of Machine	Make	Model	Capacity in tons/ cu.yds.	Engine HP make & Model	Popu-lation	Year of pur-chase	Pur-chased New/ Old	Acqui-sition cost in Rs. lakhs	Present Condi-tion	Re-marks
1	2	3	4	5	6	7	8	9	10	11	12

ANNEXURE-VI

No.1/4/77-R&C
Government of India
CENTRAL WATER COMMISSION

Bikaner House, Shahjahan Road,
New Delhi-110011, the 20th April, '77.

To

The Chief Engineer,

Subject: Committee for cost control of river valley projects

The Government of India, in the Ministry of Agriculture & Irrigation have set up a Committee for cost control of river valley projects vide their O.M. No.17(26)/76-MFE dated 25.2.77 (copy enclosed). One of the terms of reference of the Committee is to set down national norms for specifications and format for rate analysis, for water development projects.

To enable the Committee to proceed with the task, the basic information on the lines indicated below pertaining to your project will be very useful:

i) Format of analyses of rates adopted in your project.

ii) Constants of labour output or task work, based on field observations, in respect of manual operations.

iii) Cost analyses for items of works done departmentally.

iv) Output of machinery realised in practice.

v) Break up of the contract rates into principle operations, based on observations by project engineers.

The list indicated above may be considered as merely indicative. We realise that some of the data listed above may not be readily available and that it may have to be collected by a series of observation to be conducted over a period during actual construction. It is also possible that some information may be available in the records and may have to be identified and compiled. It will therefore be appreciated if action is initiated towards collection and compilation of the data, which is so vital for the deliberations of the Committee, and the information could be made available ready to Shri Mahesh Chand, Member-Secretary of the Committee.

A list of important items of work which form bulk of the project costs is enclosed. Any other item considered appropriate may also be taken up for the study. Each of the items may involves a series of operations. While data on each of the operations involved will be most useful factual data on the costs/output data even on individual operation or a group of them would also be welcome.

The Committee would in due course think of issuing a comprehensive questionnaire on these and other aspects. However, with the working season in full swing as of now it is felt some valuable data could be collected and compiled by the project officers in the course of the next 2-3 months and it is with this in view that this request is being sent.

Yours faithfully,

Sd/-
(M.G. Padhye)
Chief Engineer, CWC
(Level I) and
Chairman of the Committee

Encls: as above.

IMPORTANT ITEMS OF WORK OF HYDRO, IRRIGATION AND FLOOD CONTROL PROJECTS

1. Earthwork in excavation by manual labour
2. Earthwork by heavy earthmoving equipment
3. Transport of materials by trucks
4. Drilling and quarrying
5. Stone masonry for hearting in dams
6. Stone masonry for facing in dams
7. Mass concrete
8. Tile/concrete lining in canals
9. Radial gates
10. Vertical lift gates
11. Tunnelling
12. Permanent supports in tunnels
13. Steel penstocks
14. Concrete in tunnel lining
15. Concrete in power houses
16. Reinforcement

ANNEXURE-VII

No.17(26)/76-MFE
Government of India
Ministry of Agriculture & Irrigation
(Department of Irrigation)

New Delhi, the 25th February, 1977

OFFICE MEMORANDUM

Subject: Setting up of a Committee for Cost Control of River Valley Projects.

The crucial role played by river valley projects in the planned progress of the country has been recognised and, as a result, the tempo of their development has been speeded up. The cost of these projects has been mounting up leading to frequent revision of estimates and consequent delay in the completion of the projects and accrual of benefits therefrom have been causing great concern to the Government. The need to control cost and watch the departmental working rates or the rates being accepted for the tenders on continuing basis has, therefore, become imperative. Proper selection/classification of contractors based on their experience, resources and performance would go a long way in the speedy execution of projects. Construction planning of river valley projects will have to be labour intensive to utilise the vast manpower available in the country clearly identifying the items of work that can be handled economically by manual labour consistent with the targets set for the completion of projects. A realistic assessment of outputs of indigenous/imported equipment is also necessary through a scientific study of their performance to work out unit rates. Management of projects being complex, introduction of modern techniques in project management is called for. Efficiency and output can be improved and the cost cut down by keeping proper record of running costs and maintaining a system of regularly analysing the same. This necessitates cost control cells in States/Projects and Central Water Commission. Certain guidelines towards organisational structure and effective functioning of cost cells are to be framed. It has, therefore, been decided to constitute a Committee with the following composition:

i)	Sh. M.G. Padhye, Chief Engineer, Central Water Commission.	Chairman
ii)	Sh. V.B. Patel, Chief Engineer, Kadana Project, Gujarat.	Member
iii)	Sh. J.A. Murray, Chief Engineer, (Major Irrigation), Government of Andhra Pradesh.	Member
iv)	Sh. Hari Mohan, Addl.Chief Engineer (Irrigation), Government of Uttar Pradesh.	Member
v)	F.A. & C.A.O., Beas Project.	Member
vi)	Sh. Jagman Singh, Managing Director, Minor Irrigation (Tubewells) Corporation, Haryana.	Member
vii)	Sh. A. Nagabhushana Rau, Deputy General Manager, Hindustan Construction Corporation, Bombay.	Member
viii)	Dr. N.P. Tolani, Managing Director, Tolani Engineers Pvt. Ltd., Bombay.	Member
	(Sh. K.C. Chhablani, General Manager, Tolani Engineers Pvt. Ltd., Bombay).	(Alternate Member)
ix)	Sh. B.M.K. Mattoo, Financial Adviser, Department of Irrigation.	Member
x)	Sh. A.K. Biswas, President, Institute of Costs & Works Accountants of India.	Member
xi)	Sh. G.C. Mathur, Director, National Buildings Organisation.	Member
xii)	Sh. D. Ajitha Simha, Director, Indian Standards Institution.	Member
xiii)	Sh. A.S. Kurpad, Deputy Adviser, Bureau of Public Enterprises.	Member
xiv)	Sh. Mahesh Chand, Director (R&C), Central Water Commission.	Member-Secretary

2. The terms of reference of the Committee are:

i) To study and suggest measures for exploitation of the fullest extent of the labour resources available in the country on a continuing basis on water development projects with due consideration to the changed context in the construction work and increased degree of mechanisation necessary presently and in times to come.

ii) To set down national norms for specifications and format for rate analysis for water development projects comprising:

a) Standard description of main items of universal nature in rationalised units.

b) Standard specifications in consonance with Indian Standards in order to remove the present inconsistencies which are very often exploited resulting in loss to Government. These specifications should be clearly and unambiguously worked to enable proper quality control.

c) Standard methods of measurement particularly for items like earth work in embankments, boulder stacking and placement, over break in tunnelling etc.

d) Analysis of rates both for manual as well as machinery works based on standard constants of labour, material, tools and plant etc., in different zones of the country.

iii) To suggest measures for introduction of modern techniques of material management and inventory control, performance budgeting system adopting modern practices, resorting to computerisation, etc.

iv) To suggest general guidelines on the structure and functions of the cost accounting cell which is being set up in the projects/States on the recommendations of the State Irrigation Ministers Conference of July, 1975.

v) Study performance and out-puts of indigenously manufactured/imported earth moving machinery and lay down norms.

The Committee will submit its report within a period of one year.

The expenditure on TA/DA etc. on the Chairman and Members of the Committee in connection with the deliberations of the Committee will be borne by respective State Governments/Departments/ Firms etc.

Sd/- (J.S. NAPHRAY)
DEPUTY SECRETARY TO THE GOVERNMENT OF INDIA

ANNEXURE-VIII

NOTE ON PERFORMANCE BUDGETING

Performance budgeting, as a technique of budgetary and financial control, is by now well accepted both in Government and Industry. Until early 60's the budget of the Central Government (also of State Governments) was prepared on the basis of objects of expenditure such as, salary, allowances and honoraria, Grants-in-aid, office expenses etc. etc. in respect of works expenditure, a few other objects were also shown such as, major/minor works, tools and plant, suspense transactions, etc. These objects of expenditure were shown under the Demands for Grants allotted to the various Ministries/Departments of Government.

The Budget prepared in the above manner was found seriously wanting for any meaningful appraisal of the various programmes, activities, and projects/schemes on which large sums had been invested by Government. The periodical appraisals of such programmes, etc. was considered particularly essential due to the fact that with the launching of five year plans, the development expenditure constituted a major portion of the total expenditure. It was accordingly decided by Government that, alongwith the conventional budget (which was also reformed to reflect all the programmes, activities etc. for which money was provided), a document containing detailed information of the overall performance of each Ministry/Department, in relation to the various programmes and activities included in the conventional budget, shall be presented to the Parliament. This document which is called 'Performance Budget' now accompanies the Demands for Grants, for each Ministry/Department of the Central Government. It mentions the physical targets of the various developmental programmes/activities included in the Demands, the targets so far achieved, and short-falls, if any, along with the reasons therefor. It also aims to present a break up of the financial outlay on each of the programmes, sub-programmes and activities correlated with physical targets. It further gives an outline of the organisational framework of the implementing agencies connected with the programmes. The scope and objects of the individual projects and schemes, their estimated costs (including reasons for increases in original costs whenever necessary), the unit costs and volume or standard of performance, wherever these have been evolved, the work-load data and the staff employed for the purpose, are also included.

There is a considerable scope for improving the quality of performance budget. In most cases, norms and standards of performance have not been laid down. The budgetary allocations made for various programmes/activities are also not derived from 'net work' techniques with the result that the funds provided are not worked out on the cost-related appraisal of the physical performance of the connected programmes and activities, which often leads to either major set backs in their physical achievements due to want of funds or large sums remaining unutilized during the year.

BRIEF NOTE ON EVOLUTION OF LABOUR NORMS

The present labour norms on which the Analysis of Rates is based and Schedule of Rates are worked out by the different construction agencies are mostly worked out without sufficient backing of the scientific field data. For evolving rational output norms it is essential that the data for this has to be obtained by using modern work measurement technique. The fact that this data is at present based on empirical considerations is evident from the variations in the data noticed at different places.

Each item of construction work may be conveniently divided into labour component and material component. Whereas, material component can be comparatively easily worked out, the labour components require consistant study at site with accuracy. As is commonly known, output of labour is dependent on several factors ranging from personal skill to climatic conditions.

In its simplest form work measurement determines "how long will it take to some one to do something". Work measurement can be defined as "the application of techniques designed to establish the proper time for accomplishing a specified work by a prescribed method, carried out at a defined level of performance by a qualified worker under a given set of environments and working conditions". Thus work measurement provides basis for:

i) Quantitative assessment of human effort and

ii) Working out the proper time for effective performance of the work.

The techniques in general use are Elemental time study and Synthesis for Repetitive items of work and Analytical Estimating for non-repetitive items of work.

While carrying out field studies the aim is to arrive at "Standard Rate of performance" which implies a qualified worker, who

knows method of work and does the work strictly as per the method and is properly motivated. Such a worker is practically non-existant. Hence the studies are further modified by applying Rating factor. Rating is subjective evaluation of job as a mental concept. The standard time is further adjusted with internationally accepted allowance, climate allowance, contingency allowance, policy allowance etc. Accuracy in norms can be achieved by large number of observations. With little training field staff can carry out the studies without much difficulty.

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