Paper No. 170

CONSTRUCTION PLANNING OF SMALL HYDROPOWER PROJECTS

(Financing - Contract Packaging - Project Schedule)

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1. CONSTRUCTION MANAGEMENT

If we analyse the literal meaning of the construction Management, anybody would interpret this to "manage the construction" The question arises when the specifications, design is prescribed and the contractors are selected to execute the job and the client is ready to follow progress and make payments on the basis of agreed payment terms, what further management is required. Then what is the necessity to pay so much of importance on construction Management when each phase of planning and implementation of the construction activities automatically follow. It is exactly not like that, that "Construction Management" means only to manage the contract, it is far far beyond the literal meaning and it is too wide a speciality. Special courses have been prepared and are being conducted by different agencies to groom the Project Managers to learn the art of Management. The Project Managers are not only required to manage the construction side of the job, Project Managers should be well conversant with:

- Planning of the project, design criteria, specifications and preparation of tender documents,
- procedures for floating/evaluation of tenders, award of contracts,
- construction of the job according to specifications and design criteria. This includes to administer the contract, monitor progress of work, provide coordination between the contractors and maintain close liaison with the client and Aid-giving Agency,
- certify payments to the contractors, maintain record of all progress payments, ensure vigilance on the modification work and to keep the variation orders to the minimum,
- prepare as built drawings simultaneously with the work to show the modifications in the approved drawings,
- keep a close watch on the defective items of Plant and to ensure rectification of defects during Defects Liability Period,
- finally after the completion of the project terminate all contracts and compile the "Completion Report".

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It is worth to mention that once a contract is signed between the parties, this documents becomes a "legal tender" and flouting of any of the clauses and provisions of the contract either by client, or the Engineer or the contractor can be challenged in the court of law. The provision of the contract ensures a legal cover to redress grievances under such circumstances. If the contractor or client do not agree with the interpretation/opinion of the Engineer, initially under such circumstances the Engineer's decision is sought and in this sitution the Engineer acts as an "Arbitrator". If the contractor or the client do not agree with the Engineer's decision, they have the option to take the case for arbitration in the court of law, or select neutral parties as Arbitrators or take the case to the international Chamber of Commerce, when provided in Agreement, the agency having the headquarters in Finance and recognised internationally to settle disputes on Contracts Management matters. Although a decision finally obtained from the court of arbitration becomes binding on both parties but normally this course of action should be avoided as it is said that the party who wins and the party who losses both ultimately loose financially due to exorbitant expenses to prepare and proceed with arbitration, apart from this course being a time-consuming process. Furthermore it generates bitterness between the parties and there are very few chances that these parties work together on any other future project. The court of arbitration should therefore be avoided and efforts should be made to settle disputes amicably during the currency of the job. Project Management team i.e.the heads of the client, the contractor and the Engineer should jointly make efforts in this direction during the currency of the contract.

The importance of construction management could only be realised during the actual implementation of the construction; this may not only relate to the construction of a large dam or a large or a small hydro-power station but this applies equally even to the construction of house which is normally considered as a routine construction by the individuals who may not be engineers and undertake the work by petty contractors. For a better planning timely and economical construction of a house one is required to ensure:-

- The layout of the house is planned for a practical living. Prepare drawings showing details of the construction work.
- Mobilise all resources for financing the construction cost.
- decide whether the house is to be constructed on turnkey basis by oen contractor or bifurcate the job for civil works, electrical works, carpentry, plumbing job etc. Then select best of the contractor for each speciality job.
- Ensure that the construction work proceeds such that every type of contractor is available at the required period according to the integrated schedule to avoid delays.

When construction management plays such an important role even for construction of minor and routine nature of job like the construction of houses by the individuals, one can visualise the importance of construction management with productive outcome on construction of projects by the Agencies.

The foregoing establishes the importance and necessity of construction management of any type of construction job irrespective of cost, type and size of construction. With this background, I shall try to explain the necessity of financing resources, contract packaging, project schedules, cash flow requirement and sufficiency of plant and equipment.

2. FINANCING RESOURCES

Whether the job proposed to be undertaken is of smaller or a bigger size of construction, financing resources should be ensured and committed to suit the cash flow requirements.

In te present age of construction works being undertaken by the developing countries usually the financing for foreign element cost of the project is being provided by the developed countries or by Aid-giving Agencies to purchase the Equipment or engage Contractors from foreign countries. The local element cost being financed by own resources of that country. If the Government can afford, foreign element cost of the project can be financed out of own cash foreign resources.

Different sources of financing the foreign element costs are:-

(a) INTERNATIONAL BANKS AND AID GIVING AGENCIES

The Aid-giving Agencies viz. the Workd Bank (International Bank for Reconstruction and Development i.e. IBRD), International Monetary Fund (i.e. IMF), the Asian Development Bank (ADB), United States Agency for International Developmet (USAID), Kreditanstalt fur Wiedraufbau (KFW) of West Germany, Canadian International Development Agency (CIDA) and Export Development Corporation (EDF) Canada and Islamic Development Bank (IDB) Jeddah, Overseas Development Fund (ODF) UK etc. allocated funds to the developing countries for the foreign element cost of the project. UNIDO also finance the cost of the project but presumably for the feasibility studies which in fact is the basis to establish technical/economical viability of the project.

These Agencies howevr prescribe a definite guideline and procedure for procurement and equipment. Usually the guideline for example the World Bank and Asian Development Bank prescribe the procurement of plant/award of contract should be to the manufacturers/contractors of member countries of the Bank. Whereas KFW and CIDA prescribe procurement of equipment from the manufacturer of their respective countries viz. W.Germany and Canada respectively and this type of financing is called the tied loan or tied financing. Usually it is experienced that the prices of equipment procured from tied loans are comparatively higher as the bidding competition is restricted to manufacturers of one country.

The financing is provided by these agencies in the form of loan and in some cases the funds are provided on soft loan or by special funds etc. with varying rate of interest and period of recovery. In certain cases the funds are provided as grant with condition that the equipment is to be purchased from manufacturers of that country. For feasibility study of the project, the amount of grant could be utilised to engage the consultants from that country.

(b) OTHER TYPE OF FINANCING

The developed countries provide financing of the project in the developing countries by establishing state to state credit at very attractive terms with repayment after a considerable period. The quipment in this case is to be procured from manufacturers of that country.

The other mode of financing is by establishing "barter deals" between the Governments. According to the protocol of the barter deal, one country sells the manufactured goods and in return receives the raw material of the specified items or eatables like foodgrains, fruits etc. the speciality of that country.

In certain cases commercial credits are arranged by the manufacturers through their Government but the rate of interest and other terms of commercial credits are not so attractive.

In case the cost of the contract packing is high due to the size of the project, mixed financing can be arranged i.e. source of financing from more than one Agency or partly finance out of commercial crdits.

Each source of financing provides a guideline to procure the equipment and the terms of progress payments to the works may vary. The tender documents are required to be prepared with evaluation procedures for award of contract to the successful contractor according to the guidelines prescribed by these agencies. The tender documents prior to floating the tenders are required to be approved by these agencies and finally the award of contract should also be with the conset and approval of these agencies. These agencies also monitor the progress of work to ensure that the money provided is best utilised for the specific purpose of allocation of funds and undue delays do not occur. The Construction Management of the project however would remain the responsibility of the Client and the Engineer.

The payment procedures to the plant manufacturers and civil works contractors are also established whereby the running payment is made through prescribed letter of credit or by direct disbursement by these agencies after certification of invoices by the authorised site representatives. The foreign element cost relates to:-

- F.O.B cost i.e. the cost for manufacture of the equipment to be delivered by the manufacturer free on board.
- Foreign erection i.e. the cost for sub-assembly of plant at the works. Prior to packing and delivery of the equipment the manufacturer is required to sub-assemble the plant at the works to ensure assembly within the permissible tolerances. Before dismantling, match marks are stamped to facilitates the final assembly at site in the sequential order.
- Insurance i.e. to cover the marine insurance cost of the consignment.
- Foreign charges i.e. to cover the cost for freight charges by the shippers for the shipment.

LOCAL ELEMENT COST

The local element cost comprises of:-

- Custom and import duty charges i.e. to cover the cost for payment of all charges to clear the plant through customs.

  Note: In order to provide incentives for development works in particular regions of the country, the Government, some times waives these charges or reduce the rate of charges.
- Local Transportation Cost i.e. cost for inland transportation of equipment from the port of disembarkation of the consignment to the site of works.

- Insurance Cost i.e. the cost to cover insurance during inland transportation to the site of work, storage at site, erection and until commissioning and completion of defects liability period of the project.

Note: Usually separate insurance cover is provided for each of the above phases. Also during the defects liability period, the insurance cover ensures recovery of the replacement cost of the defective items of plant from the insurance Company.

-Local Erection i.e. cost for erection charges of the plant at site including the charges for supervisory and labour staff etc.

A typical format prescribed in the Bills of Quantity (B.O.Q) of E & M Plant tender documents for the tenderers to fill up the details of foreign element and local element costs for each of the item is shown hereunder:-

Item of Plant	FOREIGN ELEMENT COST				LOCAL ELEMENT COST				TOTAL
	FOB	Erection	Insurance	Shipment	Total	Erection	Local Trans-port	Insurance	Total

METHOD OF PAYMENT TO THE CONTRACTOR IVOICES

Although the activity of this topic falls under the construction of implementation group of the Construction Management, it is however considered that it would be not out of place to describe in brief the usual procedures of method of payments prescribed in the tender documents as under:-

CIVIL WORKS CONTRACT

For the civil works contract, immediately after the award of the contract usually certain amount is given to the contractor as molilirations cost and which is not recoverable. However further interest free financial assistance is given to the Contractor for purchase of machinery valuing certain percentage of the tender price. The machinery remains in the name of the Employer and the cost is recovered in equal instalments from the running bills.

The bills are paid on monthly basis termed as monthly invoices for the amount of work done during the period. Certain percentage of the amount of the invoice is deducted as "Retention Money".

E & M PLANT CONTRACTS

In the case of electrical and mechanical works contracts, clause containing Terms of Payment is specially prescribed in a foreign financed Erection Supervision Contract expressed in broad terms as under:-

- 15% of F.O.B cost paid as down payment.
- 15% of F.O.B. cost paid six months after down payment
- 55% of F.O.B cost paid after delivery of Plant at site.

- 10% of F.O.B cost paid on the date of taking over certificate
- 5% of F.O.B. cost after completion of defects liability.

Similarly the terms of payment for other items like insurance, freight charges and local erection are also clearly defined in the Contract Documents.

Note: It is not necessary that the foregoing procedures should always be adopted and the terms of payment could be modified and improved according to the terms of financing and conditions imposed by the Aid-giving Agencies or mutually agreed between client and the contractor at the time of negotiation/award of contract. In certain cases better terms of payment could be offered to provide incentives to the manufacturer to expedite progress and advance the completion of the works. The economic analysis/present net worth of such incentives usually proves such arrangements as beneficial to the Employer.

The best administered contract is the one which has the least number of claims, variation orders or additional cost over and above the tender price due to poor management or deficiencies in design and specifications of the tender documents requiring modifications issue of variation orders during the construction stage. It is however very rare that the job is completed within the tendered amount, however appropriate planning and systematic implementation of construction would definitely minimise the amount of additional cost over and above the tender price.

3. CONTRACT PACKAGING

In the present age the art of the game is for specialisation by the individuals and the companies, and research studies are being undertaken by the individuals and the companies to advance their knowledge and technology in the specific field of their Engineeing. The Engineering organisations normally work with the concept of specialities in relative field of Engineering like Hydraulic, Hydrology, Geotechnical, Structure, Architecture, Mechanical, Transmission, Sub-Stations, Distribution, Master Planning, Computers, Generators, Protection, Contracts etc. etc. Even Construction Management falls under a specific group of speciality.

Similarly in the field of construction and manufacturing industry in particular for manufacture of Plant and Equipment, the manufacturers select the field of Engineering and by undertaking research in the field of Engineering specialise in the manufacture of Plant. There is no doubt that some large size industries are specialists on manufacture of different type of Plant, but if you carefully examine their set up of factories, they have different industrial units under different management for the manufacture of specialised Plant. You may have observed that in the world there are specialised manufacturers separately for Turbines, Generators, Cranes, Switchgear Trasnformers, Cables, Protection Equipment etc.

All Hydropower Projects whether small or large involve construction of civil works and supply, installation, testing and commissioning of Turbine, Generators, Transformers, Switchgear and Cables. For handling of the Plant and Equipment, cranes are needed; for connecting the Turbine with the Reservoir for pressure head, tunnel/penstock would be required; for creating operating and closing conditions of the water passage, gates and valves are required. Specialist manufacturers are available in the world for each type of equipment. It is always advantageous to float the tenders and purchase the Plant from the specialist manufacturers. It can only be done by bifurcation of the contracts termed as Contract Packages.

The specifications for the scope of work of each Contract Package are prepared separately and usual Packages are:-

1. Civil Engineering Works
2. Penstock
3. Cranes/Lifts
4. Turbines
5. Geneators
6. Transformers
7. H.V. Switchgear
8. Protection/Control Equipment
9. Isolated Phase Bus
10. Cables
11. Gates/Steel Structure

It is the discretion of Client/Engineer to bifurcate the contracts into any number and reduce the number of Packages by grouping. Mangla and Tarbela Dams/Power Stations were undertaken with more than 12 Contract Packages. Tenders for Chashma Hydropower Station 12 x 22 M.W. have recently been floated, wherein initially the tender documents were proposed with 16 Contract Packaging, finally they were grouped in 3 Packages, two for E & M Plant and one Civil Works.

Apart from advantage of selecting the specialist manufacturers, different Contract Packages assist to bifurcate for the source of financing. The disadvantage is that this would considerably increase the quantum of work on engineering and coordination by the Engineer. Irrespective of this, I personally recommend bifurcation of scope of work into different Contract Packages to get the Plant from the specialist manufacturers.

MODE OF EXECUTION WITH DIFFERENT CONTRACT PACKAGING.

Since the Civil Engineering Works Contractor is the first to mobilise and last to demobilise and responsible for embedment of all Plant, comparatively more responsibility and increased Scope of Work is given to this contractor. Different methods of execution of the jobs are:-

(a) Nominated Sub-Contractors

(b) Supply and Erection Basis

(c) Supply and Erection Supervision Basis

(d) Supply Basis

Each mode of Scope of Work should be specifically defined in the Tender Documents so that the Tenderers could offer the prices accordingly. The method of execution of each of above type of execution is described hereunder:-

(a) Nominated Contractor

The tender for the Civil engineering Works includes the Scope of Work, Specifications, B.O.Q. of the E & M Plant and the Tenderers of Civil Works are instructed to quote the prices for the E & M Plant and nominate the name of manufacturer. Sometimes the Civil Works Contractor nominates manufacturers of the E & M Plant from where he proposes to purchase the Plant pursuant to the award of Contract. Under all circumstances the nominated manufacturer will have to be approved by the Engineer/Client. In this type of construction, Civil Contractor is completely responsible for the whole job and he shall have to appoint specialist engineers of the nominated manufacturer in different fields to undertake the work. Engineer/Client should satisfy the capabilities and personnel of the Contractor/nominated manufacturer.

(b) Supply and Erection Basis

In this type of contract the E & M Plant manufacturer shall be responsible for manufacture and supply of the Plant to site and subsequently undertakes the erection and testing of the Plant under his own management of all the affairs of erection work. This includes clearance of plant through customs, local transport, storage and handling of plant at site etc.

(c) Supply and Erection Supervision Basis

In this type of execution of job, the E & M Plant manufacturer is responsible for the manufacture of Plant and supply the Plant to the site for hand over to the Civil Contractor who shall be responsible for storage, handling, erection, installation, testing and commissioning. Since the Plant belongs to the manufacturer who is a specialist and he is also responsible for satisfactory operation of Plant during the Defects Liability Period, the manufacturer therefore is required to provide the specified number of Supervisors at site to work with the Civil Contractor for installation, testing and commissioning of the Plant.

In certain contracts like construction of Mangla Dam and Tarble Dam, this type of execution was followed except the Civil Contractor was held responsible to receive the Plant at the manufacturer's premises rather than the Plant is handed over to Civil Contractor at the site.

(d) Supply Basis

In this type of execution of the job, the E & M Plant manufacturer hands over the Plant to the Civil Contractor at the specified location and the installation, testing and commissioning of the Plant to be undertaken entirely by the Civil Contractor.

The "Supply and Erection Supervision" mode of execution is the most suitable. The advantages being:-

- The Plant is supplied by the specialist manufacturers. Also they provide the supervision as required and simultaneously take full responsibility for installation, testing, commissioning and for the Defects Liability of the Plant.
- In the case of Supply and Erection Contracts, the Manufacturers will have to establish the organisation for custom clearance, transport, handling of Plant and this would lead to additional cost and dual management.
- In the case of Supply and Erection Supervision Contracts, the labour, handling equipment etc. will be the responsibility of the Civil Contractor and his work force and facilities could therefore be best utilised.
- The biggest advantage of Erection Supervision Contracts is that the site coordination work of the Engineer would be with only one Contractor and there would be no claim of delays for hold up of work by one Contractor due to area not handed over by the other Contractor or crane busy with the other Contractor etc.

QUALIFICATION CRITERIA

In order to eliminate contractors inexperienced/not specialised in the desired field of Engineering and without sound financial support, Civil Works Contractors are prequalified by inviting notice for prequalifications. The usual procedure adopted to prequalify the Contractors is that notice is published in the Newspapers of the Intention to Prequalify the Contractors. The interested Contractors submit particulars on the prescribed form of their experience, personnel, equipment, finances, past performance record, details of equipment, litigation cases and if their services were terminated because of performance etc. For prequalification of the contractors a formula is evolved by allocating marks for different sub-heads like experience, finance, past performance personnel, equipment etc. and the proposal submitted by the contractor for prequalification is evaluated by following this criteria. The tenders are finally issued to only the prequalified contractors.

In the case of E & M Plant, the manufacturers are post-qualified on the basis of the data to be filled by them in their tenders. The usual information requested in the Tender Documents to be filled by the manufacturer is as under:-

- Names of projects undertaken during the last 5-10 years.
- Projects of similar and identical works designed/manufactured/installed during last 5-10 years.
- Names of sub-manufacturers with their experience details on similar projects.
- Financial position.
- Names of personnel with references.

- Financial status - cases of arbitration - Bonus earned/ penalties levied.

Only the tender submitted by the firm who meets the prescribed qualification criteria is considered in evaluation.

4. CONSTRUCTION SCHEDULE

One of the most important item of construction planning is the construction Schedule. The Schedule should show the bifurcation of Contract Packaging with details of items of each activity of the Contract Packaging. The sequence of construction and the duration and timing to undertake and complete the activity, the sequence and duration of the activity should be realistic i.e. it should neither provide excessive period nor a short duration. The most important item of the Schedule is to show the exact timing of the inter-related activity so that there is no confusion/discrepancy to establish the start of activity and duration to complete.

In particular for execution of works involving more than one Contract Packaging, bonus/liquidated damages should invariably be prescribed to ensure timely completion and to avoid claim by one contractor waiting for completion of that item by other contractor. Sometimes this situation could lead to the serious implications and such cases could lead to litigations and reference to Arbitration. Special emphasis should be given for adequate vigilance to the schedule of activities of critical and interlinking activities with the activities of other contracts.

The status of progress of each activity and the overall status of the progress of work of the schedule should be monitored periodically. The usual method of monitoring apart from the general vigilance is by "C.P.M. Netowrk" and/or "Pert Master" System. Attached is schedule of a Hydropower Project prepared as a Project Construction Schedule and developed as C.P.M. Network and Pert Master.

5. CASH FLOW REQUIREMENTS.

Obviously before planning the execution of the project, the most important aspect is to ensure (apart from feasibility of the project) to establish the cost estimates to complete the project and that the source of financing is defined. It may be kept in mind that the construction of Hydropower Projects takes comparatively longer periods than other type of projects as apart from tendering and evaluation/contract award process which normally takes about 8 months for all contract packaging this involves foundation engineering, construction of structure of the building etc. by the Civil Works Contractor; meanwhile the manufacturers are required to procure material design, undertake model studies, manufacture, shop assemble/testing and then despatch the plant to site. After the plant is delivered at site, this will be installed by following the integrated construction schedule until the commissioning of the unit and completion of defects liability period. Usually the construction period of Hydropower projects extends over 3 to 4 years of completion. Keeping such long period of completion, the contract provides for escalation and price variation due to currency fluctuations, in other words the tender price may vary considerably due to the escalation factor on material and labour cost and similarly due to variation in rate of exchange between the currency of the country of the client and the currency of the country of manufacturer/contractor. In order to establish the price variation due to fluctuation of exchange rates, the basic exchange rates of the applicable currencies of the relevant countries prevailing one month before the tender opening date is notified. Similarly for escalation

on material and labour definite escalation formula is prescribed in the Tender Documents to be filled by the contractor which becomes the basis of computation of escalation cost payable to the contractor.

The other factor which would result in variation in cost is the price of specified materials like fuel, cement, steel. The price of these items applicable at the time of tender opening is notified and variation in prices of these items during the currency of contract shall be paid as extra charges on the bills to be submitted by the contractor duly supported with proof of relevant notification by the Authorities showing change in price.

It may also be notified that the terms of payment sometimes prescribe payment of interest charges @ a specified rate for delayed payments of running bills of the contractor. It is very important that cash flows should be realistic otherwise there may be problems in the allocation of the funds for the project at the specific time, resulting in delay in payments which may lead to payment of interest on the amount of invoice.

The cost estimates should therefore include all the possible variations in prices due to the foregoing items. After establishing the final cost estimates, cash flows are drawn.

While preparing the cash flows, apart from the variation in cost, the terms of payments, the schedule of construction and interest charges applicable during construction should also be taken into consideration. The terms of payments for example prescribe advance or down payments soon after the signing of Contract Agreement and this allows payment to the contractor for procurement of special equipment in the form of a financial support to the contractor etc. Similarly the schedule of payment prescribes payment on monthly basis for Civil Works Contractor, the anticipated progress of work and the quantum of work should be estimated to assess the likely amount of payment to be included in the cash flow. In the case of O & M Plant, the terms of payment apart from down payment prescribe, payment on shipment, after presentation of the Shipping Documents, upon installation of certain percentage of Plant; upon issue of Taking over Certificate and final payment is settled upon completion of the Defects Liability Period. Cash flows therefore should cater for the anticipated progress/quantum of work.

6. CONSTRUCTION EQUIPMENT

The construction equipment comprises of tools and plant, cranage and hauling equipment and the importance of the tools and plant does not warrant any emphasis as without the tools no work can be done. Even a pen is a tool for the writer as without a pen he cannot express in writing and similarly without any equipment no job can be undertaken.

It is not only to have the equipment which is important but most important is to have the right type of equipment for the particular type of job and the equipment should be in working condition with sufficient quantity of spare parts for prompt replacement.

"Sufficiency of Equipment" available with the contractors is one of the most vital factors which is given due consideration while evaluating the contractors request for prequalifications to submit tender and during the evaluation of tender for award of contract. Since the construction equipment is a very expensive item and the contractors procure jobs on more than one project and they wish to utilise the equipment on different projects, it is therefore essential to evaluate

the contractors resources of equipment, the condition of equipment, the jobs in hand with the contractors and the future jobs that are likely to be procured by the contractor. Proper assessment of all these factors and if required to depute Engineers to the contractors yards for personal verification of the details of equipment would establish the "Sufficiency of Equipment" with the contractor.

Following is the typical Table used to evaluate and asess the "Sufficiency of Equipment":-

Description of Equipment	Quantity Required as assessed by the Engineer	QUANTITY					Short fall as assessed by Engineer	Date of availability to suit the construction schedule
		Available with the Contractor	Proposed to be procured from Market on hire	Available with Sub-Contractor	New purchase	Total		