

# ITA Position Paper on Types of Contract

## ITA Working Group on Contractual Practices in Underground Construction

**Abstract**—This paper describes the following contracting concepts applicable to tunnelling and other underground construction work: Design-Bid-Build; Partial Design-Construct or Partial Design-Build; Design-Build and Turnkey; and Build-Operate-Transfer. Advantages, disadvantages, and related risks are summarized for each type of contract. Aspects of multiple construction contracts and contracting with an association of contractors are addressed. The three main methods of pricing—lump-sum, cost-reimbursable, and unit-price—are discussed in detail. Other aspects of compensation, such as bonus payments, currency of price, adjustment and revision of price, and payment conditions, are also addressed.

### 1. General

**A**n owner who intends to contract for the construction of a tunnel or other underground facility has a choice of entering into a single contract with a single enterprise, which will be responsible for performing all the obligations needed for the completion of the construction, or dividing the obligations among several parties, entering into an individual contract with each party. Within each of these two techniques, there are different possible approaches to contracting, as discussed below. These approaches differ in important respects, for example, the extent of the responsibility of the contractor, the extent to which the owner must coordinate construction, and, in many cases, the total cost to the owner.

Whether it is advisable for the owner to enter into a single contract or several contracts may depend upon several factors. Entering into a single contract places the responsibility for the entire construction on a single party. If several contracts are entered into, and the works upon completion are defective, it may sometimes be difficult to determine which contractor is liable. Where the technology is highly specialized or is the exclusive property of a single supplier, the entire works may have to be designed and constructed by the supplier of the technology. The owner may wish to enter into different contracts for, e.g., the transfer of technology, the supply of the design, and construction of different portions of the works only if he has the ability to coordinate and evaluate performance by several contractors.

Mandatory legal regulations in the country of the owner may require that a certain contracting approach be used by the owner. For example, those regulations may require that firms in the owner's country be engaged for certain

aspects of the construction (e.g., civil engineering design) in order to develop the technological capability of the country and to conserve foreign exchange. In such cases, the owner will have either to contract with a single contractor who is prepared to engage local enterprises as subcontractors, or to enter into several contracts, including contracts with local enterprises. In addition, the extent of the contractor's liability to taxation may influence the contracting approach to be chosen by the parties. The parties may wish to obtain expert advice on the issue of taxation.

In the process of creating a functional tunnel or other type of underground facility, a contract usually exists between the tunnel owner and the contractor. On major projects of great complexity, the owner may let several contracts to different contractors to accomplish discrete portions of the works. Historically, the common contractual arrangement is one in which the owner first develops a definition of the facility he wants created and also defines the site and the conditions at the site which may influence the construction methods, schedule and cost.

The level of the owner's definition of the tunnel structure and ancillary facilities he wants built has varied, but two general practices have been common worldwide. In one of these, the design definition is advanced only through preliminary design and preliminary specifications, and the tenderers propose to perform detailed design and to construct. Such a contracting concept is referred to as "design-construct" or "design-build". When the scope excludes portions of the project work which are to be accomplished otherwise, the term, "partial design-construct" or "partial design-build" are used.

The other commonly found contractual arrangement is one where the owner completes the tunnel design including the details and the technical specifications, then calls for tenders for construction only. This alternative contracting concept is referred to as "design-bid-construct" or "engineered design". In both of these contracting concepts, the terms of reference, as they relate to compensation of the contractor, may call for tenders on a firm fixed price basis, however, the owner's bid form usually provides a

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breakdown of the work into cost units to establish better bases to negotiate changes to the defined work (see Section 8, "Compensation Alternatives").

The varying risks to the parties under these two contractual concepts are generally recognized. However, over recent years, other contractual concepts have evolved and are being elected by more and more owners of tunnels and other underground facilities. These concepts pose the same and some new risks. In these newer concepts, the owner is seeking more from the contractor. In addition to final design and construction of a discrete portion of an overall project, the industry is experiencing calls for tenders which include:

- A scope of work which is all-encompassing including not only the basic tunnel structure but all related structures and constructions, equipment procurements and installation (e.g. ventilation, lighting, control systems, finishes) and completion of a ready-to-use facility. This contractual concept is referred to as "turnkey".
- A scope which requires the contractor to not only complete the design and construction, but start-up, operate and maintain the tunnel facility for a specified period, train the owner's personnel and transfer the facility to the owner at the end of the agreed period of operation and maintenance. This contractual concept is referred to as "build-operate-transfer" or simply "B-O-T".
- A scope which is design-build, turnkey or B-O-T but which also requires the tenderers to offer financing for all or a portion of the contract cost. With the addition of a financing requirement, the term "super turnkey" has been applied and, in general, the B-O-T contractual approach includes financing requirements.

In summary, tunnel owners have a wide range of contracting concepts from which to choose when they embark on the initial planning and definition of their projects. Recognized here are:

- Design-Bid-Build
- Partial Design-Construct or Partial Design-Build
- Design-Build and Turnkey (may include contractor financing)
- Build-Operate-Transfer (includes contractor financing)

All of the two-party agreements listed above contain the fundamental terms of scope of the contractor's work, schedule or time of completion, and price, including the method or basis of contractor compensation. Each of these concepts has advantages and disadvantages to each party and each carries a different set of risks. Such risks are particularly prevalent to one or both parties when the owner elects to use a contractual concept that is inappropriate for the project circumstances. The advantages and disadvantages of each of these concepts give insight to the proper use of each concept and to the risks which are presented to the parties.

## 2. Multiple Construction Contracts

The owner may divide the construction of the works among two or more contractors. The transfer of technology and the supply of the design may also be affected by one or more of these contractors, or may be affected by other enterprises. The owner must coordinate the scope and the time of the obligations to be performed under each contract so as to achieve his construction targets. The owner may bear risk of delay in construction or defects in the works resulting from his failure to determine appropriately in each contract the equipment, materials and construction services to be supplied by the different contractors, and the time-schedules to be observed by them.

*"The cost-reimbursable method may be appropriate . . . when the extent of construction services or materials and the kinds of equipment needed for the construction cannot be accurately anticipated at the time of contracting . . . or where a substantial part of the construction is to be done by subcontractors and the prices to be charged by them are not known at the time of conclusion of contract negotiations."*

In addition to resulting in a lower price, the engagement of several contractors for construction could facilitate the use by owners from developing countries of local contractors to construct portions of the works, perhaps under the supervision of an experienced foreign contractor. The use of local contractors in this manner may save foreign exchange and facilitate the transfer of technical and managerial skills to enterprises in the owner's country.

When several contracts are entered into for construction, the supply and installation of equipment and the supply and installation of finished materials are often effected under one or more contracts, and heavy civil design and construction under other contracts. The equipment may in some cases be installed by the owner's personnel or by a local enterprise under the supervision of the contractor. However, the way in which the construction is to be apportioned among the various contractors will depend upon the nature and the size of the works, and the national policy followed by the country of the owner. In general, the less complex the works, the smaller the number of contractors required and the easier it is for the owner to coordinate the scope and the time of the construction obligations under the different contracts. The risks connected with coordination increase when a large number of parties participate in the construction.

The risks borne by the owner in coordinating the scope and the time of the performance of the obligations of several contractors could be considerably reduced by employing a consulting engineer to advise the owner as to how to achieve proper coordination. A consulting engineer (the "Engineer") may be employed even if the design-build, turnkey or B-O-T approach is used, though his function in such cases may be primarily to check the quality and the progress of the construction to be effected by the single contractor.

The owner may, as is increasingly the practice, engage a construction manager (sometimes called a project manager) with a wider scope of responsibility instead of, or in addition to, a consulting engineer. The construction manager might also be the designer of the works, or an expert with management capabilities.

The responsibility of the construction manager need not be limited to giving advice, but may include integrated construction management (e.g., inviting tenders or negotiating and concluding different contracts for the various portions of the works for and on behalf of the owner, coordinating all site activities and controlling the construction process). If the construction manager is not the de-

signer, the contract may obligate him to check the design and to assume responsibility for design defects that he could reasonably have discovered. The construction manager might also be obligated to advise the owner on the selection of contractors.

The fee paid for the services of a construction manager is usually higher than the fee of a consulting engineer because of the wider scope of the construction manager's responsibility. The parties might agree that the fee is to be reduced according to a specified formula if the works are completed late or if the cost of the construction is higher than a target cost, and increased if the works are completed early or the cost is less than the target cost.

Another technique that the owner might wish to adopt in order to reduce his risks in coordination is to have one of the contractors assume responsibility for some part of the coordination. This contractor may, for example, be obligated to define the scope of the construction to be effected by other contractors to be engaged by the owner, and to provide a time-schedule for that work. He may also be obligated to check the construction effected by the other contractors and to notify the owner of defects in the construction which he could reasonably have discovered. However, in considering this approach, the owner should take into account the possible conflict of interest which it might create for the coordinating contractor, since he has to evaluate the performances of fellow contractors who might be participating closely with him in the construction or in construction elsewhere. Accordingly, the owner may wish to adopt this technique only in exceptional circumstances.

A further approach that the owner might wish to adopt in order to reduce his risks in coordination is to provide that one of the contractors is to be responsible for the transfer of the technology, the supply of the design for the entire works, and the construction of a vital portion of the works. This contractor may also be obligated to define the scope of the construction to be effected by other contractors to be engaged by the owner and to provide a time-schedule for that work.

The contractor may be obligated to hand over to the owner at an agreed time a completed work capable of operation in accordance with the contract, unless he is prevented from doing so by the failure of another party engaged by the owner to perform his construction obligations in accordance with the design, specifications or time schedule provided by the contractor to the owner. An advantage of this approach for the owner is that the responsibility for the transfer of the technology, the supply of the design and the construction of a vital portion of the works is concentrated in one contractor.

Another approach available to the owner is to conclude a tunnel contract with a single contractor for the construction of the entire works in accordance with a design to be supplied to that contractor and to engage one or more enterprises other than the contractor to transfer the technology and supply the design for the works. The design is usually obtained by the owner before the tendering procedure or negotiations for the works contract commence, in order that tenders to construct may be solicited on the basis of the design. Since the contractor under this approach is responsible for the construction of the entire works in accordance with the design supplied by the owner, his responsibilities for coordinating the construction process and constructing the entire works are the same as those of a turnkey contractor. The contract may obligate the contractor to notify the owner if he becomes aware of any inherent defects in the design.

### 3. Single Design-Build and Turnkey Contracts

The contractual concepts whereby a single contractor is engaged to perform all obligations needed for the completion of the entire tunnel and related works, i.e., the trans-

fer of the technology, the supply of the design, the tunneling, the supply of equipment and materials, the installation of the equipment and the performance of the other construction obligations are referred to as the "design-build" or the "turnkey" approaches. Either approach requires the contractor to coordinate the entire construction process, and, in principle, results in the contractor's liability for any delay in completion of the construction or for defects in the works.

Where the owner chooses the design-build or turnkey contract approach, and decides to solicit competitive tenders to construct the works from potential contractors, each tender made by a potential contractor will be based (within the parameters set in the invitation to tender) on an individual design. The owner will thus be able to choose the design which is most responsive to his requirements. In addition, since the design-build or turnkey contractor is himself to supply equipment and to construct pursuant to the specifications contained in the design included in his tender, that design may reflect manufacturing and construction economies and techniques available to the contractor, and thus result in construction which is economical and efficient. On the other hand, it may sometimes be difficult for the owner to evaluate and compare the different designs and different potential contractors. It is therefore advisable for the owner, when soliciting competitive offers, to invite all potential contractors to set forth the specific advantages of the design, methods, and construction elements of their offers.

In preparing the design and construction methods and selecting subcontractors, a design-build or turnkey contractor sometimes may be motivated more by a desire to offer an attractive price than by the need to ensure the durability, reliability and ease of maintenance of the works. However, a turnkey contractor usually has no incentive to over-design the works (i.e., to include in the design unnecessary features and technical safeguards to ensure that the tunnel and its equipment perform in accordance with the contract), since overdesigning would make such contractor's offer noncompetitive. Where the design is supplied by a separate designer, there may exist some incentive to overdesign.

### 4. Build-Operate-Transfer Contracts

In some cases, a single contractor, in addition to assuming the obligations of coordination of all work, may undertake to ensure that after the works are completed, the facility can be operated and achieve agreed-on efficiency using the owner's own personnel or the contractor's personnel. This approach is referred to as the "build-operate-transfer" approach. It may be used by the owner as a means of making the contractor responsible, not only for the completion of the entire works, but also for a period of in-service operation and maintenance followed by an effective transfer to the owner's personnel of the technical and managerial skills and knowledge required by personnel for the successful operation of the works.

In contrast to the case where the contractor merely undertakes to train the owner's personnel in the operation

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of the works, this approach requires the contractor to ensure that the training is successful. Accordingly, the contract should specify the results that the contractor is obligated to achieve through the training. The contract may provide that the training must enable the owner's personnel to operate the works during an agreed-on test period under the guidance of the contractor's managerial personnel. The contract might impose greater responsibility on the contractor by providing that the training must enable the owner's personnel to operate and manage the works independently during the test period.

The B-O-T contract approach is to be distinguished from the turnkey contract, where the turnkey contractor undertakes in the contract to apply his own personnel in only the start-up operation of the works after its completion.

A single contractor bears a high degree of risk in performing all the obligations needed for the completion of the works. He may insure against this risk, or provide some financial reserves to cover the risk. The costs of adopting these measures is usually reflected in the calculation of the price. The total price of the works may be lower if several contractors are engaged than if a single contractor is engaged since, under the approach involving several contracts, the owner himself effects the coordination of the construction process, which, under the single contract approach, is effected by the contractor.

Under the B-O-T contract approach, the contractor not only assumes extensive operating, maintenance and training obligations, but also bears the risk of failing to achieve the agreed-on results. Thus, the contract price of a B-O-T project is likely to be higher than that charged under the turnkey contract approach. However, it is difficult to compare a B-O-T and a turnkey price.

The final choice by the owner among the various approaches may be guided by considerations that go beyond the financial costs of the construction. Alternatives to both the turnkey and B-O-T approaches may add to the staffing needs and the risk costs of the owner.

## 5. Contracting with an Association of Contractors

The construction of complex and large-scale underground facilities may be beyond the technical or financial means or the experience of a single enterprise. This may be the case, in particular, where all or a substantial part of the works is to be constructed under a single contract, such as in a B-O-T contract or a turnkey contract. In such instances, one possibility may be for a single enterprise to enter into the contract as the contractor, and to engage subcontractors to perform those obligations which it cannot itself perform.

Another possibility may be for a group of companies to combine to perform the obligations of a contractor. A group of enterprises may be created, not only for the purpose of pooling the experience and the technical and financial means of the members of the group, but also to satisfy eligibility requirements (e.g., those concerning the nationality of the contractor) which may be imposed by law, by the owner or by a financing institution, or in order to take advantage of financial or fiscal benefits available to contracts meeting certain requirements.

The terminology used to describe a group of enterprises which has combined to perform the obligations of a contractor is not uniform in all legal systems. For example, the terms "joint venture" and "consortium" may sometimes describe the same types of arrangements, while at other times different types of arrangements are implied by the terms. Furthermore, the use of a term in a contract may carry with it certain legal consequences under some legal systems. Accordingly, where the owner is entering into a contract with a group of enterprises, it may be advisable for the contract to describe clearly the responsibilities and

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liabilities undertaken by the group or its members.

In some cases, the members of a group of enterprises, which have combined to perform the obligations of the contractor under a tunnel contract, may form an independent legal entity. In such cases, the contractual provisions of the contract will be the same as those in a contract between the owner and a single enterprise. The entity itself will be fully responsible for the performance of all the obligations of the contractor under the prime contract.

Whether the individual members of the group will be responsible will depend upon the nature of the legal entity. Some legal systems may have mandatory rules governing contracts entered into by an owner with a group of enterprises integrated into an independent legal entity. The parties may need to take such rules into account in negotiating the contract.

In other cases, the members of the group do not integrate into an independent legal entity. In such instances, there are matters which it would be advisable for the tunnel contract to address which do not arise in contracts with a single enterprise or with a group of enterprises integrated into an independent legal entity. Firstly, it would be advisable for all members of the group to become parties to the contract. Secondly, it would be advisable for the contract to set out the responsibilities and liability of the members of the group to the owner in the performance of the contractor's obligations.

Under one approach, the contract may allocate specific obligations to each member of the group and make him liable for the performance only of the obligations allocated to him. In this case, the legal positions of the parties will be similar to those connected with an approach involving multiple contracts. Under a second approach, the contract may allocate specific obligations to each member of the group, but make the members of the group jointly and severally liable to the owner for the performance of all the obligations of the contractor under the contract.

From the owner's point of view, it may be desirable for each of the members of the group to assume joint and several liability for the performance of all the obligations of the members, instead of each member assuming liability only for obligations to be performed by him. With joint and several liability, the owner would be able to claim performance against any one or a combination of the members of the group without having to attribute the failure of performance to a particular member, and each member would be personally liable for any such failure. In the event of a successful claim, the owner would be able to execute his award against the combined assets of the members against whom he claimed. It may be noted that the owner may

protect himself against the effects of a failure of performances by obtaining performance guarantees from the members of the group.

It may be advisable for an owner who is contemplating entering into a single contract with a group of contractors, who have not integrated into an independent legal entity to obtain legal advice with respect to the possible consequences or difficulties which may arise due to the use of such an agreement. In addition to matters mentioned above, there are a number of other issues which the owner may wish to consider when entering into a contract with a nonintegrated group of enterprises:

- a. How the difficulty of bringing a claim against enterprises from different countries, should a dispute arise, may be overcome;
- b. How the settlement of disputes clause may be formulated so as to enable any dispute between the owner and several or all of the members of the group to be settled in the same arbitrable or judicial proceedings;
- c. How guarantees to be given by third parties as security for performance and quality guarantees to be given by members of the group are to be structured;
- d. How the financial arrangements between the owner and the group may be settled, including such questions as the manner of payment of portions of the price to members of the group;
- e. What ancillary agreements may have to be entered into by the owner; and
- f. Whether there are any mandatory rules of the applicable law governing contracts of this type.

Should the group not be integrated into an independent legal entity, it may be to the advantage of all the parties for the owner not to have to deal with each member of the group in matters arising during the course of performance of the contract. The members of the group may therefore want to designate one of their number to be spokesman for the group in their dealing with the owner. Thus, notices to be exchanged between the parties could be exchanged between the owner and the designated spokesman. It may be advisable for the authority of such a spokesperson to be specified in the contract. The owner will need to know whether the spokesperson has any authority to make decisions which are binding on all members of the group. The group of enterprises may provide the spokesperson with certain authority to act on behalf of the group, as for instance, in defending a claim made by the owner.

## 6. Summary of Advantages, Disadvantages, and Related Risks

It falls to the owner to select the most advantageous packaging of his heavy construction work, related procurement, equipment installations, finish construction, testing, start-up preparation and initial operations and maintenance. A tunnel or other underground facility can have a wide range of functions, technical complexity, geographical extent and impacts on third parties and the environment. The span of concepts and uses ranges from a simple water supply tunnel for a hydroelectric plant to an operational rail transit metro or subway to a complex, fully equipped linear accelerator with test chambers.

Obviously, each project presents unique requirements that influence, if not govern, the packaging of the owner's work to be contracted out. In some cases, the actual tunnelling work and installation of permanent ground support systems are a minor proportion of the owner's investment, despite the relatively high cost of tunnelling or other kinds of underground construction and despite the inherent risks in the creation of underground space.

No summary of the advantages, disadvantages and risks or alternative scoping and approaches to contracts

can be complete; therefore, despite the ITA's distaste for disclaimers, the completeness of what follows is hereby disclaimed.

## A. Design-Bid-Build

In many countries, the dominant practice for major public sector tunnelling projects has historically been linear, i.e., completion of design under direct control of the owner using his staff or consultants, followed by a call for tenders to general construction contractors. Listed below are the apparent advantages and disadvantages to an owner of the design-bid-build contracting approach to a complex scope tunnel project.

### 1. Advantages

- The owner controls the design process through the 100% level of design completion and can make in progress design changes at little expense for rework or redirection. The owner is assured, in terms of project scope and detail, that his goals are met.
- The final design process carried out by the owner's staff or a consulting engineer occupies time during which the owner can complete all or most of his third party agreements and resolve third party design and construction issues. Rights-of-way can be certified early and locked into the design process, and yet changes can be accomplished as a result of issues relating to site acquisition or evolving site conditions. This process can involve property owners, public agencies, utility entities, and permitting agencies. In addition, feedback from the equipment systems contracts during and after preliminary design completion can be readily incorporated into the heavy facility design work before tenders are taken or even up to the final tender document addendum.
- This approach permits the owner to choose its final design team through accepted professional selection procedures. In addition to greater assurance regarding quality of design work, the owner also has greater opportunity to achieve other objectives, as the use of local engineering firms.
- The packaging of on-site construction may be tailored by the owner to best fit his objectives, such as cost effective sizing, reservation of work for small contractors, and sequencing of work to accommodate third-party schedules.
- Where the approach is used most often, it is more familiar to contractors and design consultants, it can use the owner's existing specification and general conditions, and it does not force unusual or unfamiliar teaming and alliances.

### 2. Disadvantages

- The approach forces design to be completed on a basis general enough to attract a significant number of tenderers, regardless of the experience, equipment and leadership of each contender. On occasion, design alternatives may be prepared and offered to tenderers to better ensure competition, but these methods increase the cost of, and time for, design.
- Detailed design and construction are separated into distinct phases which in general force a longer period for project completion. Although some possibility exists to give a priority to critical activities or contract units—such as advanced site clearing and utility relocation work, or owner procurement of long-lead time items and perhaps even underpinning of adjacent buildings—in general, more time is required between approved preliminary designs and completion of all construction.

- Contractor financing is less likely to be obtained using this contracting approach because of the many relatively-small contracts involved.

### 3. Risks

- There is less risk to the contractor(s) under this contracting approach. The owner and his design engineer establish the total scope of construction and all finishing work required by completing detailed design and construction specifications, thus resolving all functional, aesthetic and finishing requirements. The owner performs constructability reviews. All impacts of construction, including any need to make changes in the existing facilities of third parties, are identified during design. All rights-of-way needed for the permanent facility and its operation are likewise acquired prior to contracting. There is more time for site investigation, including vital geotechnical investigations and related testing. Overall, there are more defined bases for tendering which should sharpen competition and reduce the likelihood of disputes between the owner and the contractor. In general, risk is reduced by reducing the areas of unknown or poorly defined constraints.
- Conversely, the owner has taken on the responsibility for detailed design and for the coordination of all work across the larger number of contract interfaces.

### B. Partial Design-Build

The combination of detailed (i.e., final) design and construction into a single contract—the so-called Design-Build or Design-Construct approach to contracting—has found favor in private industry and is also in common use in parts of the world for public sector linear projects, such as development of a tunnel facility. The term “Partial Design-Build” is also used; it refers, for example, to the application of the contracting method for the heavy civil facilities only, leaving the equipment systems and finishing to be contracted for by a separate series of contracts similar to the design-bid-build contracting approach described above.

The advantages, disadvantages and risks of this approach are given below.

#### 1. Advantages

- A driving force behind this approach to contracting is reduction in total cost and claims via a competitive, fixed-price bid.
- By combining all civil, structural, architectural and related electrical and mechanical design and construction into a single contract, final design work may be tailored to the construction capabilities of the contractor, the final design is represented only on working drawings, not on completed tender documents; and the contractor can fast-track the work, ordering materials and mobilizing equipment as soon as requirements are known. These conditions reduce the overall time needed for design and construction, as well as their costs.
- The combination of all detailed design and construction into a single large Partial Design-Build contract significantly reduces contract interfaces across which coordination must be effected by the owner and his Engineer. Many interfaces between design and construction contracts and among construction contracts are removed from the owner's responsibility and become internal tasks for the sole contractor. However, in the Partial Design-Build case, the equipment systems contract interfaces remain under the control of the owner and his Engineer, including those between

equipment systems suppliers-installers, finish contractors and the partial design-build contractor.

- The exclusion of equipment systems work (i.e., ventilation systems, pumping systems lighting, fire protection systems) from heavy construction work avoids the combination of dissimilar types of work into a single package, forcing strange alliances between industries not familiar with their new associates' businesses. Systems work is packaged conventionally, which is, in itself, a form of design-build (actually, design-fabricate-install).
- The monetary value for the large Partial Design-Build contract may offer the owner the opportunity to solicit contracting financing, if that is under consideration, while not restricting competition.

#### 2. Disadvantages

- The owner advertises and bids the Partial Design-Build contract based on preliminary design that varies from a 20 to 35% level of design completion. Detailed design by the contractor is based on these preliminaries plus the owner's design criteria, design standards and appropriate standard or definitive designs. Once the Partial Design-Build contract is bid and awarded on a fixed-price or lump sum basis, the owner must pass through the variations clause of the contract before making design changes and loses control over design, except as provided in the contract. If the owner must make changes in criteria or preliminary designs for any reason, it may have to negotiate cost and schedule adjustments with the contractor, very likely at a premium cost.
- At the time of award, design has progressed only through preliminaries, and all third-party issues may not have been identified, or resolved. Responsibilities must either be assigned to the contractor for resolution or retained by the owner. Neither alternative is particularly attractive. The contractor usually has less leverage than the owner and may have to buy his way through unresolved third-party issues (a contingency in his bid). The owner will pay dearly when it must address third-party controlled changes and contractor delays derived from late resolution of these issues by the owner.
- Professional design work is submerged in the large Partial Design-Build contract, and the owner has much less control over the qualifications of the design team and little to say about where and how design work is accomplished, unless an approval or review power has been reserved in the contract. The owner should require legally qualified design engineers and architects and can stipulate other constraints (e.g., design shall be performed in the local area), but these latter requirements add to cost. Local and other design professionals find themselves unable to seek design work except by association with a contractor, the likely prime. They will thus be forced to assume a greater amount of responsibility for the project and will have to assist the contractor with bid preparation on a marketing basis, for little or no remuneration. This may not be an attractive proposition to the local industry nor the engineering profession as a whole.
- The exclusion of systems work from the Partial Design-Build contract still leaves many interfaces across which control and coordination must be effected by the owner and his Engineer. As the equipment systems contracts are bid and awarded, and as those contractors advance their designs, changes to the preliminary design given to the Partial Design-Build contractor will have to be made. This is a more

serious problem than in the Design-Bid-Build method because the increased cost of making changes and the probable fast-tracking of construction by the design-build contractor may preclude some changes.

- The size of the Partial Design-Build contract may limit the number of national contractors who can qualify and be bonded, but it will likely attract international bidders. This is listed here as a political disadvantage.

### 3. Risks

- Preliminary designs and specifications will not be detailed enough to give the owner a satisfactory end result. The contractor will operate to minimize his costs and maximize his profit, hence he might be tempted to cut corners wherever he can. Contractually, he is free to do this so long as he does not conflict with his contract and its reference documents (e.g., preliminary design drawings, outline specifications, design criteria and standards). Among the kinds of opportunities the contractor may have are those which reduce first cost, but increase operating and maintenance costs and reduce life.
- Changes desired by the owner in order to achieve an acceptable product will be owner directed changes to be paid for as added cost. A result may be a significantly higher first cost to the owner.
- The owner will experience a lack of direct access to the contractor's design team in resolving final design matters and design changes. The contractor's representative will filter and restrict any directions to the designers in order to control capital and engineering costs and to upgrade and formalize such directions to owner caused changes and a change order to be negotiated. The owner may want to implement an approval or review power over construction documents.
- Any commitments made by the owner to obtain rights-of-way and third-party agreements consistent with the contractor's programme may fail somewhere and to some extent. The consequences of such failure might include delay claims by the contractor and added expense to the owner.
- Incomplete and inadequate definition of existing conditions, especially geotechnical conditions, as included in the tender documents, leaves the owner with little basis to oppose a differing site conditions claim by the contractor. The consequences may include favourable award of claims to the contractor and higher cost of the owner's facility.

### C. Design-Build and Turnkey

Under this contracting concept, all detailed (final) design, construction, procurement and system-wide installations are packaged together for competitive tendering and award. The tender documents are at level of detail and completion comparable to Partial Design-Build, but all work is combined into one very large contract. It is normal in some jurisdictions to carry the equipment systems and system-wide contract components to the level of a completed "performance specification." The term "total turnkey" could be applied to this approach, except for the many third-party interfaces for which coordination responsibility must be allocated by the owner. If wholly assigned to the contractor, the concept becomes a total turnkey contract. Certain advantages and disadvantages to the parties of this type of contract are listed below.

### 1. Advantages

- The design, construction, procurement, installation and testing are compressed reducing the time for completion. In addition, the overall cost of work should be lower following the allocation to the contractor of the majority of design and construction tasks, which will reduce contingencies. Cost reduction effects similar to those cited under Partial Design-Build apply here.
- The number of interfaces external to the contractor where the owner retains coordination responsibility are reduced to a minimum. Those remaining will tend to be third-party relationships. The likelihood of owner-controlled changes and delays is greatly reduced, with attendant reductions in overall cost to the owner.
- In maximizing the size of the contract, the owner will have attracted international contracting competition, with increased possibility of a foreign national financing subsidy, if that is of interest in the owner's financing plan.
- Other advantages exist as cited above under Partial Design-Build.

### 2. Disadvantages

- By combining dissimilar types of work (e.g., rail transit tunnel construction and subway station finishing and equipping) into a single contract, the owner forces many prospective marriages (joint ventures and prime/sub arrangements) to be worked out on a potentially worldwide basis by contenders. A very strong prime entity is hoped for—one that understands the spectrum of work and is experienced in such a complex management project—but there is no assurance such strength will also be lowest responsible, responsive bidder. It becomes a gamble made acceptable by perceived advantages. The owner and his Engineer will not want to step in later and become the coordinators between the contractor's major suppliers of equipment and construction. As the bundling of work and procurement into a total package expands, the degree of control by the owner lessens.
- Disadvantages described under Partial Design-Build also apply to this approach.

### 3. Risks

- By using a single turnkey contractor, the owner has put all of his eggs into one basket with the attendant risk of failure. The owner will not have other contractors at hand to step in quickly and pick up where the single prime contractor has failed.
- The complexity of the single turnkey contract demands a strong management staff to deal with diverse team members and subcontractors. Experience has shown that the owner (and his Engineer) cannot always avoid participating in the coordination of work among subcontractors and component suppliers. With a more diverse scope, as in the case of a whole-project-turnkey, there is even greater need to coordinate among designers, constructors, fabricators and installers. There is added risk that the contractor will fail to do this and that the owner and his Engineer will have to step in rather than watch the situation deteriorate.
- This total project award places much higher importance on the contractor selection process. The tendering process is fraught with risk and must be carefully and conservatively handled. Risks attendant include:

- Selection of a less-than-best consortium due to “low-ball” pricing which cannot be upset by qualification ranking.
- Forced acceptance of a consortium which includes good capacity in some areas (e.g., tunnel construction) and poor capability in other areas (e.g., ventilation system design and fabrication).
- Exposure to project-stopping lawsuits brought by one or more tenderers challenging the award proposed to be made to one tenderer.
- Need to thoroughly pre-qualify actual tenderers through a tight screen which may involve two steps and many months before a “safe” call for tenders can be made.
- Strong likelihood that tenderers will be international consortia, with the attendant challenges of language, idiom, currency exchange risk, and legal premises.

(All of these risks can be found in smaller size contracts; however, there is more to fight for in the one total package, raising interest among those involved).

#### *D. Build-Operate-Transfer (B-O-T)*

A B-O-T is a turnkey contract followed by a defined period of operations and maintenance by the contractor at the end of which control of the facility is transferred to the owner. It has also been referred to as “super turnkey.” Internationally, there is increasing use of B-O-T contracts for major undertakings.

Under this method, the owner not only enters into a single contract for total project development up to ribbon-cutting, but he also engages the contractor to operate and maintain the constructed and tested facility for a specified period of time (such as five to ten years), following which the contractor withdraws and the owner takes over. The more obvious advantages and disadvantages to the owner of this type of contract are as follows:

#### **1. Advantages**

- The contractor must not only complete the total underground facility and check out all equipment systems, he must actually operate and maintain the facility for a specified number of years. The owner may be better assured of an efficiently operating and easy to maintain/repair unit under the B-O-T contract approach.
- The owner is not immediately faced with acquiring and training operating and maintenance personnel, but has passed this chore on to his contractor, who can be required to provide training of the owner's staff in advance of the end of his contract. Also, the operations and maintenance personnel of the contractor will likely become employees of the owner.
- There may be financial advantages to a B-O-T contract over and above those of the turnkey contract, depending on what financial arrangement the owner seeks. Once operations commence, user fees or revenues are collected and operating and maintenance costs are experienced. Where facility income cannot offset operating and maintenance costs, the contract may provide for a subsidy to be paid by the owner as well as any amortization of first cost. If the owner's financial resources are deferred or metered, the B-O-T contractor could help with cash flow shortfalls, but only at a price in interest which eventually must be paid by the owner.
- Other advantages exist for B-O-T as cited above under Design-Build or Turnkey approaches.

#### **2. Disadvantages**

- The owner is removed from the public service being rendered by the B-O-T contractor after opening day. Although the owner may contract for operating personnel who convey a desirable image and for a quality of service which is acceptable, control over such matters may be wishful thinking. Changes to operations and maintenance procedures and quality desired by the owner may become change orders, at added cost to the owner, or matters of dispute. The public may not understand or care that the owner, a public agency, is at arm's length from day-to-day operations.
- The B-O-T contractor may be motivated financially to contain or reduce operating and maintenance costs in order to maintain or maximize profits, with resulting deterioration of the quality of service, life of equipment and safety. This will be a particular concern as the time for “transfer” approaches. The contractor who is leaving the operation and maintenance will be tempted to “economize”, leaving the owner with a substandard facility to correct.
- If the owner operates and maintains other facilities with established agreements with organized labor, the operations and maintenance of the next facility by the B-O-T contractor could pose problems of jurisdiction, disparities in wage rates and benefits and other conflicts, especially as the time for “transfer” approaches.
- The disadvantages described under Design-Build or Turnkey also apply to the B-O-T contracting approach.

#### **3. Risks**

- A B-O-T contract spans many years including time for final design, construction, finishing, testing and operation and maintenance. There is risk in trying to project at the outset the best contractual terms for all of the services required of the contractor, including financing all or part of the project. Many public works owners have difficulty in making long term financial commitments because they are subject to annual budget cycles and the vagaries of government and public office holders. The owner's funding sources may not produce the funds needed for construction, operation, maintenance and loan amortization, as scheduled. The owner may have to stretch out the work with the incumbent added expense of delay or develop alternative sources of funding. These circumstances could call for additional financing by the contractor at less attractive terms than those originally agreed. Results include delayed completion of work, delay in operations, higher cost of money and overall higher cost of the project.
- The level of operations, availability of service and quality of maintenance should be specified in some way by the owner, because it will be the owner and not the contractor who will be berated if the public suffers. However, the operations and maintenance period is at the end of the contractual period, when the contractor is most concerned about loss prevention and profit protection. The owner may not have adequate influence, even under the contract, to force the contractor into more acceptable practices. There may not be incentive enough to provide good service to the public, except by outright direction by the owner at added cost to the owner.

The final year or so of O&M will pose the greatest risk in this regard, when turnover to the owner is approaching, and the incentives to maintain are at, low ebb. The owner may find it has a facility with a large

backlog of undone maintenance and a near-term need to begin replacing worn-out or damaged components.

## 7. Other Considerations

### A. Management of the Contractors

In all cases, the owner, either directly or by engagement of an Engineer or project management consultant, will have to closely monitor its contractors. The use of larger contracts with fewer interfaces does not relieve the owner of the need to be aware of day-to-day progress in design, construction or fabrication. The larger the contract package, the more difficult it will be for the owner to remain informed and spot trouble as it appears and before it escalates. This is particularly true of design work, where the design entity of a design-build contractor may be inaccessible except via a construction engineer or project liaison staff member not necessarily experienced in design.

### B. Financing by the Contractor

The selection of a method of contracting and the packaging of work may be largely influenced by the owner's perceived need for financing assistance. There are likely two or more motives or objectives where this is the case:

- (a) to smooth out the owner's requirements for cash, flattening somewhat the peak demand for construction/procurement payments and extending such payments over a longer period; and
- (b) to obtain funding at rates of interest less than those likely to be obtained under more conventional forms of borrowing (Refer to Section 8.F(5)).

In the first case, the owner "uses" the contractor's funds by agreement to defer payments to the contractor, and the contractor, in effect, becomes a lender. In many such arrangements, a mandated lender (i.e., a bank or other lending institution) may be directly involved and may actually be a third contractual party. The "collateral" for such an arrangement is often guaranteed by the State, a national bank, or an equally solvent body. By this mechanism, the owner avoids selling bonds of some type or engaging in some other more direct form of borrowing.

In the second case, the rates of interest charged the owner must be equal to or lower than he would pay via bond sales or other direct financing. It is unusual for a turnkey contractor to have access to funds at rates lower than that of most owners. However, this has been experienced where a foreign national government or development bank is bankrolling the contractor in order to favour that nation's commerce or sale of construction materials and system equipment. In other words, the government of a member

nation has a policy of selectively subsidizing project development internationally in order to boost trade and sell its national products. Because of these circumstances, a tunnel owner can expect international competition when it calls for tenders including contractor financing. This means lessened home-nation content and contractual terms which are international in scope for administration.

The owner who seeks contractor-financing has the challenging proposition of writing the "specification" for financing as well as for the design, construction and possibly the operation of the underground facility. The owner must also indicate how tenders will be evaluated, including the financial offers and the first cost of the tunnel or other structure. The owner wants to attract innovative financing proposals and yet must have at hand some criteria by which these will be compared for relative attractiveness. The credit and reliability of the funding source come into play. Complications present themselves, such as the owner trying to levy liquidated damages for late construction completion against its banker.

Probably the most challenging aspect is the overall evaluation of tenders. The tenderer with the lowest (first) cost may not be the preferred contractor, once his financing offer is considered. Of greater concern is the likelihood that a marginal proposal on technical grounds (past quality of work, track record, equipment offered, etc.) may be selected due to a financing package which offsets the lowly-ranked technical proposal.

## 8. Compensation Alternatives

### A. General

There is, in general, no direct or universal correlation between the scope of contract and how the contractor is compensated for his work under the contract. However, there is a correlation between how well the work is defined and the site conditions known and how rigid or fixed the compensation may be at the time of contracting. The objective of both parties to a tunnelling contract should be to seek equity in its terms and a part of such equity is a reasonable allocation of risk between the owner and the contractor.

The formulation of contractual provisions relating to the price to be paid by the owner must take into account a number of factors. The price will often cover varying aspects of construction by the contractor, e.g., the supply of equipment, materials and services, and the transfer of technology. A considerable period of time may elapse from the date of the contract until the completion of construction, and, during that period, the costs of construction may change. In addition, the extent of construction to be effected may not be precisely determinable at the time of contracting. The parties should decide who is to bear the consequences of changes in costs and reflect their decision in the contract. When construction of the tunnel is financed by an international lending institution, that institution may require certain issues to be settled in particular ways.

Three main methods of pricing are in common use in tunnel contracts: lump-sum, cost-reimbursable, unit-price methods. However, in appropriate circumstances, two, or all three methods may be used in combination for pricing different aspects of the construction.

1. *Lump-sum method.* Under this method, the parties agree on the total amount to be paid for the construction. This amount remains constant even if the actual cost of construction turns out to be different from that anticipated at the time of contracting, unless the contract or the law applicable to the contract provides for an adjustment of the price.
2. *Cost-reimbursable method.* Under this method, the owner is obligated to pay all reasonable costs incurred by the contractor in constructing the tunnel,

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*"Three main methods of pricing are in common use in tunnel contracts: lump-sum, cost-reimbursable, unit-price methods. However, in appropriate circumstances, two, or all three methods may be used in combination for pricing different aspects of the construction."*

together with an agreed fee to cover the contractor's profit and overhead.

3. **Unit-price method.** Under this method, which may be used as a complement to the other methods, the parties agree on a rate for a unit of construction, and the total contract price is determined by the total number of units actually used. The pricing method may be practical only with respect to certain portions of the construction.

(Each of these three payment methods is described more fully under paragraph B. below, "Methods of Pricing".)

It is advisable for the contract to specify the price, or a method for determining it. Under some legal systems, the contract is not valid if it does not do so. Under other legal systems, however, the contract is valid, and if the parties fail to agree upon the price at a later stage, the price is determined in accordance with the rules of the legal system. However, the rules for determining the price may not be appropriate for construction contracts.

In choosing a pricing method and drafting the payment conditions, the parties should consider applicable foreign exchange regulations and other legal rules of an administrative or other public nature. The violation of those rules may result in the invalidity of the contract, or of some of its provisions, or in the termination of the contract by operation of law. Special problems may arise in connection with the price to be paid for the transfer of technology. The price and the payment conditions relating to the supply of spare parts and the maintenance, repair and operation of the facility by the contractor after the completion of construction may also have to be covered by the contract.

In drafting contractual provisions on price, the parties should take into consideration legislation in the country where the tunnel is to be constructed which imposes taxes in connection with certain aspects of the construction. Under some tax legislation, the owner may be obligated to pay, on behalf of the contractor, the taxes for which the contractor is liable in the owner's country and may be able to deduct the amount of the taxes paid from the price payable to the contractor. Practices under other legal systems permit the purchaser to undertake to pay the taxes on behalf of the contractor without right of reimbursement from him. International treaties on avoidance of double taxation concluded between the countries of the parties may be relevant to the settlement of some taxation issues in the contract.

## **B. Methods of Pricing**

### **1. Lump-sum method**

Under the lump-sum method, the contractor is entitled only to the price set forth in the contract, regardless of the actual costs incurred by him during the construction. The mere use of the term "lump-sum price" may be insufficient to achieve this result. Accordingly, it is advisable for the parties to include in the contract clear provisions to this effect.

The parties may wish to provide for an adjustment or revision of the price in certain defined circumstances. The lump-sum method of pricing may be suitable for use in the single contract approach. It may also be used when an approach involving several contracts is chosen, particularly in the cases where, at the time of entering into the contract, the extent of construction is known and significant changes in the scope and quality of the works at a later stage are not anticipated.

For practical reasons, it may be advisable to break down the lump-sum price into specific amounts payable for different portions of the works, or amounts payable for equipment, materials, different kinds of services and the transfer of technology. Such a breakdown may facilitate adjustment or revision of the price in certain cases envisaged in the contract. In addition, a breakdown will be needed if different payment conditions are agreed upon for different portions of the works, or for the performance of different kinds of obligations by the contractor. Tax legislation or other regulations of a public nature may also require certain elements of the price to be specified separately, e.g., the portion of the price to be paid for a transfer of technology.

The main advantage for the owner of the lump-sum method of pricing is that he knows the total price that he will be obligated to pay and that the contractor bears the risk of increases in the cost of construction. However, this advantage will be reduced to the extent that the lump-sum price may be adjusted or revised. Moreover, the owner is obligated to pay the lump-sum price even if the costs incurred by the contractor turn out to be lower than those anticipated at the time of contracting. Another advantage of a lump-sum contract for the owner is that the administration of such a contract is normally less burdensome than under the unit-price method, where the extent of construction completed must be measured in order to determine the price to be paid, or under the cost-reimbursable method, where the costs incurred by the contractor must be verified.

Since the contract price in a lump-sum contract may include an amount to compensate the contractor for bearing the risk of increases in the cost of construction, the price may be higher in some cases than if the cost-reimbursable pricing method were used for the same construction. In addition, the lump-sum pricing method requires a precise specification in the contract of the scope of the works. It might also be advisable for the owner to monitor the performance by the contractor to ensure that the contractor is not tempted to reduce his construction costs by using substandard materials or construction methods.

### **2. Cost-reimbursable method**

If the cost-reimbursable method is used by the parties, the exact amount of the price is not known at the time of

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entering into the contract, since the price will consist of the actual costs of construction incurred by the contractor, plus a fee to cover his overhead and profit. This method of pricing requires more detailed contractual provisions than does the lump-sum method in order to value the actual costs incurred.

The cost-reimbursable method may be appropriate in a limited class of cases. For example, it may be appropriate when the extent of construction services or materials and the kinds of equipment needed for the construction cannot be accurately anticipated at the time of contracting (e.g., where the tunnel has not been completely designed because of the speed at which construction has to be commenced, or where a substantial part of the underground conditions cannot be accurately predicted), or where a substantial part of the construction is to be done by subcontractors and the prices to be charged by them are not known at the time of conclusion of contract negotiations.

This method may also be used in cases where the construction presents unusual difficulties (e.g., special design or complex engineering) involving many unknown factors which affect pricing. In cases such as those, a lump-sum alternative might have to include an amount sufficient to protect the contractor against his risks. This amount may often turn out to be high in the circumstances.

The main disadvantage of the cost-reimbursable pricing method for the owner is that he bears the risk of an increase in the costs of construction over those anticipated at the time of contracting. Financing institutions are therefore often opposed to this method of pricing. It is advisable for the owner to have a reasonable estimate of the costs of construction at the time of entering into the contract.

#### *a. Methods for Reducing Owner's Risk:*

In order to reduce the risk for the owner, it is advisable for the contract to obligate the contractor to construct the works efficiently and economically, and to entitle him to the costs of construction only to the extent that they are reasonable. In practice, however, it may be difficult to enforce or apply such general obligations. In some cases, the parties may agree upon a ceiling on the total amount of reimbursable costs or a system of target costs. Furthermore, the fee of the contractor may be structured so as to give him an incentive to minimize the costs of construction (Refer to "c" below).

As a means to control costs to be reimbursed, the contract may require the participation of the owner in the selection of subcontractors if they are not specified in the contract. Such participation makes this pricing method inappropriate for most turnkey contracts. An essential aspect of a turnkey contract is that the contractor assumes responsibility for constructing works which will operate in accordance with the contract. The contractor will usually assume that responsibility only if he is allowed to choose his subcontractors freely.

The risk to the owner of an increase in construction costs under a cost-reimbursable contract may be limited by providing a ceiling on the total amount of reimbursable costs. Another approach may be for the parties to agree, at the time of entering into the contract, upon an estimate of the costs of construction (i.e., a "target cost"), which is not, however, to constitute a ceiling on the total amount of reimbursable costs. The contract might provide that, if the actual costs exceed the target cost, the contractor is to be paid only a percentage of that excess. The contract might also provide that this percentage is to decrease as the excess increases.

Alternatively, the parties may agree that, if the actual costs exceed the target cost by a specified

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amount or percentage, the owner may terminate the contract without being liable to the contractor for costs incurred by the contractor incidental to the termination. The right of the owner to terminate may give the contractor an incentive, however, the owner may face the difficult choice of having either to refrain from terminating the contract and to proceed with construction by the contractor, with an obligation to pay him reimbursable costs exceeding the target cost, or to terminate the contract and complete the construction by engaging another contractor, bearing in mind the effect this would have upon schedule and total costs. Further, the continuous nature of a tunnel drive will usually render impractical the changing of contractors in mid-project, except under the direst of circumstances.

#### *b. Determination of Reimbursable Costs*

It may be desirable for the contract to provide a method of determining which costs are reimbursable and which are to be borne by the contractor out of his fees. In order to prevent disputes as to which costs are reimbursable, it is advisable either to enumerate the costs to be reimbursed and to provide that all other costs are to be borne by the contractor, or to enumerate the costs which are not reimbursable and to provide that all other reasonable costs are to be reimbursed.

The contract may specify which overhead expenses of the contractor are to be excluded from the costs which are to be reimbursed by the owner. These excluded costs may include, for example, the costs connected with the operation of the contractor's home office. In addition, telephone, postal and cable expenses may be excluded, even if they are incurred on the site. However, wages and other reasonable costs connected with the stay of the contractor's personnel on the site might be regarded as reimbursable by the owner to the contractor.

In some cases, the cost-reimbursable method may not be appropriate for pricing equipment manufactured by the contractor to be used in the construction. In those cases, it is advisable for the contract to provide an amount to be paid for that equipment by the owner. The cost-reimbursable method may, however, be used for supplies obtained by the contractor from subcontractors and suppliers.

Routine items of equipment or materials taken from the contractor's stocks may have been bought by the

contractor at various prices before commencement of or during the construction, and disputes may arise on how to value them. Such disputes may be prevented by stipulating their prices in schedules which form a part of the contract.

The contract might provide that costs incurred in employing subcontractors and suppliers are to include only costs actually paid by the contractor, taking into account discounts granted to the contractor by subcontractors and suppliers. However, the parties may wish to consider whether discounts granted to the contractor against payments in cash by the contractor are also to be taken into account. They might consider, for example, that the contractor should receive the benefit of cash payments made from his own funds, rather than funds advanced to him by the owner.

The smooth progress of construction requires that all the necessary materials be available on the site in accordance with the time-schedule. In some cases, however, it may be very difficult to envisage the precise quantities needed for construction. The contractor may over-order and may incur losses in the resale of unused excess materials. The parties may wish to consider whether and to what extent such losses are to be reimbursed by the owner. The contract might, for example, set a limit to which the losses are to be reimbursed.

*c. Fee To Be Paid To Contractor*

The fee to be paid to the contractor might be fixed at a specified amount. The contractor may provide for an adjustment of the fee in case of variations of the extent of construction. Fixing the fee at a specified amount gives no particular incentive to the contractor to minimize his costs of construction, although he may be generally interested in completing the construction as soon as possible in order to receive the fee. It is not advisable for the fee to be calculated as a percentage of the actual costs of construction since this mechanism may provide an incentive to the contractor to increase those costs. Such a method of determining the fee is forbidden under some legal systems.

A method of providing for the contractor's fees is to specify a "target fee" to be applied in combination with the target cost. If the reimbursable costs are less than the target cost, the target fee would be increased by a specified percentage of the saved cost. The contract might also provide that, as the saved costs increase, the percentage payable is also to increase. If, however, the reimbursable costs are more than the target cost, the contract might also provide that as the excess increases, the percentage to be deducted is also to increase.

In addition to the costs of construction, other factors might be regarded as relevant in increasing or decreasing the target fee, such as the time taken to complete construction, and the performance of the completed work. It may be noted that providing an incentive to the contractor to lower the costs of construction by varying the fee payable may be combined with an incentive based on an obligation to share the costs of construction when they exceed a target cost.

*d. Maintenance of Records*

To ensure a smooth operation of the cost-reimbursable method, the contract might require a system of record keeping which would accurately give evidence of the costs incurred by the contractor. For example,

the contractor might be required to maintain records in accordance with forms and procedures reasonably required by the owner reflecting charges incurred and payments effected by the contractor, and the parties may provide that the owner shall have access to those records.

**3. Unit-price method**

Under the unit-price method, the parties agree on a rate for a unit of construction. The total price to be paid is dependent upon the number of construction units used for the construction. The rate fixed for a construction unit should include an increment representing the contractor's profit. The construction unit may be a quantity unit of materials needed for the construction, (e.g., a ton of cement for concrete), a time-unit of construction, (e.g., a hour of labour in excavation), or a quantity unit of construction result (e.g., a linear measure of lined tunnel). Different construction units may be appropriate for different portions of the construction (e.g., material units for construction of an air plant, time-units for installation of equipment).

The unit-price method may be desirable where the quantity of materials or the quantity of construction services needed for a portion of the construction cannot be envisaged accurately at the time of entering into the contract, and for this reason it is difficult for the parties to determine a lump-sum price. In most cases, this method can be used only in combination with other pricing methods, since it is not suitable for pricing elements of the construction which, by their nature, cannot be divided into several identical units (e.g., equipment). It may be used, for example, for engineering, building and installation of equipment. In a contract in which it is difficult to control the quantities of units to be used for construction (e.g., in a turnkey contract where the techniques of construction are left to the discretion of the contractor) it would be advisable for the owner to take necessary measures to assess a fair price for the construction effected.

If the parties choose the unit-price method, and the contract does not provide for a revision of the unit price in the event of changes in unit costs, the risk of increases and the potential benefits arising from decreases in construction costs are divided between the contractor and the owner. Since the price per construction unit is firm, the contractor bears the risk of an increase of the costs of materials and labour for each unit or receives the benefit of a decrease in those costs. The risk of an increase in the estimated total contract price due to the need to use more units for the construction than anticipated at the time of entering into the contract is borne by the owner, while he receives the benefit if fewer units are needed.

The owner's risk may be reduced by providing in the contract that the owner is to pay for quantities up to a specified maximum, but that the contractor would have to bear the costs, or a specified percentage of the costs, of quantities beyond that limit. In some cases, the contract might also provide for an increase or a decrease in the unit price where the actual quantity of units exceeds a specified

*"The unit-price method may be desirable where the quantity of materials or the quantity of construction services needed for a portion of the construction cannot be envisaged accurately at the time of entering into the contract . . ."*

percentage of an estimated quantity. Since the price payable by the owner depends on the number of units needed for the construction, it is advisable to agree in the contract on adequate and clear methods of measuring the quantities used in order to avoid disputes.

### C. Bonus Payment

In cases where the owner is interested in the completion of construction and the commencement of the operation of the tunnel as early as possible, he may be willing to pay a higher price, in the form of a bonus payment, if the construction is successfully completed by the contractor prior to the date fixed for completion in the contract. The amount of the bonus may represent a share of the estimated material benefits accruing to the owner from an earlier commencement of the operation of the tunnel. It is not usually advisable to provide for a bonus payment for early completion of construction if the cost-reimbursable pricing method is used in the contract, since this might induce the contractor to incur higher costs in order to complete the work quickly and obtain the bonus.

For the calculation of the bonus, the parties may determine the estimated benefits to be gained by the owner for each day of earlier completion of the tunnel. This amount of money per day may then be expressed in the contract as a fixed amount, or as a percentage of the contract price if lump-sum pricing is used. Representing the bonus payment as a percentage of the price or fee will enable the amount of the bonus to change if the price or fee changes (e.g., due to adjustment or revision of the price, or cost savings in comparison with the target cost). This would to some extent enable the bonus to take account of changes in price levels. If the unit-price method is used, the amount may remain as a fixed amount per day of earlier completion. Whether the bonus payment is specified as a fixed amount per day or as a percentage, it may be limited to a maximum amount.

It is advisable to provide for payment of the bonus to be due only after the completed tunnel and any related equipment systems have operated continuously for a specified period of time. This approach may deter the contractor from adopting methods of construction which are less time consuming, but which result in defective construction. The period of time for continuous operation of the works might commence at the time of takeover or acceptance of the works by the owner.

### D. Currency of Price

The currency in which the price is to be paid may involve certain risks for a party arising from the fluctuation in the purchasing power of the price currency and from the fluctuation in exchange rates between the price currency and other currencies. If the price is to be paid in the currency of the contractor's country, the owner bears the consequences of a change in the exchange rate between that currency and the currency of his country. The contractor, however, will bear the consequences of a change in the exchange rate between the currency of this country and the currency of another country in which he has to pay for equipment, materials or services for the construction.

If the price is to be paid in the currency of the owner's country, the contractor bears the consequences of a change in the exchange rate between this currency and the currency of his country. If the price is to be paid in the currency of a third country which the parties consider to be stable, each party bears the consequences of a change in the exchange rate between this currency and the currency of his country. Where a financing institution has granted the purchaser a loan for the construction of the tunnel, the owner may prefer the price to be paid in the currency in which the loan is granted.

*"The currency in which the price is to be paid may involve certain risks for a party arising from the fluctuation in the purchasing power of the price currency and from the fluctuation in exchange rates between the price currency and other currencies."*

In stipulating the currency in which the price is to be paid, the parties should take into consideration foreign exchange regulations and international treaties in force in the countries of the contractor and the owner, which may mandatorily govern this question. The parties should also take into account that under some legal systems, the price in an international contract must be paid in the currency in which it is denominated, while other legal systems may permit, or even require, payments in the currency of the place of payment, even if the price is denominated in a foreign currency.

In cases where the parties use the lump-sum or unit-price method of pricing, the risk borne by the contractor arising from fluctuations in exchange rates will be reduced if the price is to be paid in the same currencies in which he must pay for equipment, materials and services connected with the construction. If this approach is adopted, the price for various portions of the works may be payable in different currencies. The contractor may also reduce, to some extent, the risk of fluctuations in exchange rates by specifying in his subcontracts that the price is to be paid in the same currency as that in which the price under the prime contract is to be paid. Even in these cases, however, except when the currency is that of his own country, the contractor will bear the consequences of a change in the exchange rate of that currency occurring between the date when he bought the currency to pay the subcontractor and the date when the price under the prime contract with respect to the subcontractor is paid to him by the owner.

If the parties use the cost-reimbursable pricing method, the contract might stipulate that the contractor's costs are to be reimbursed to him in the same currency in which they are to be paid by him. Alternatively, it might provide that the costs are to be reimbursed in the same currency as the currency in which the fee is to be paid. If this approach is adopted, and the costs are payable in a currency other than the currency of the fee, the costs will have to be converted into the currency of the fee at a particular rate of exchange. It is advisable to provide in the contract that this conversion is to be made at the exchange rate prevailing at a specified place on a specified date. This date may be either the date on which the costs were incurred by the contractor (in this case the owner will bear the risk of a change in the exchange rate from that date until the date when the costs are reimbursed by the owner to the contractor), or the date when the costs are reimbursed by the owner to the contractor (in this case, the risk will be borne by the contractor).

If the country of the owner has scarce foreign exchange resources, it may be interested in ensuring that at least a portion of the price is to be paid in the currency of the country. The contract might provide for the currency of the owner's country to be used for payment with respect to those costs of construction which are incurred by the contractor in the owner's currency (e.g., payment of local labour or subcontractors, or costs of accommodation of the contractor's personnel in the owner's country). This approach might be used even in cases where the lump-sum pricing method is used in the tunnel contract. Such a contract might specify the part of the lump-sum price to be

paid in the local currency, on the basis of an estimate of the costs to be incurred by the contractor in that currency.

Another method denominates the entire lump sum price of the contract in a foreign currency, but provides that costs incurred in the local currency, after they are ascertained, are to be paid in the local currency and deducted from the lump sum at a specified exchange rate. The contract might also provide for a change in the currencies in which the price is denominated where supplies foreseen to be procured from local sources become unavailable and imports of those supplies from foreign sources are authorized.

The contract might denominate the price in a currency which the parties consider to be stable, but provide that it is to be paid in another currency. The effects of such an approach may be similar in substance to those achieved by a currency clause and restrictions imposed by the applicable law with respect to currency clauses may also apply to such provisions. If this approach is used in the contract, it is advisable to agree on the exchange rate which is to apply between the currency in which the price is denominated and the currency in which the price is to be paid.

That exchange rate may be defined by references to the rate prevailing at a specified place on a given date. If the price is formulated on a lump-sum or unit-price basis, the contractor may prefer for the contract to specify that the relevant date is to be the date when the price is actually paid. If the price is determined on a cost-reimbursable basis, one of the dates referred to herein above might be specified.

It is not advisable for the contract to denominate the entire price for the contract scope in two or more currencies, and allow either the debtor or the creditor to decide in which currency the price is to be paid. Under such a clause, only the party having the choice is protected, and the choice may bring him unjustified gains.

### *E. Adjustment and Revision of Price*

In view of the long-term and complex nature of a tunnel contract, the parties may wish to provide for lump sum price or rates in a unit price contract to be adjusted or revised in specified situations. Since, under the cost-reimbursable method of pricing, the owner reimburses the contractor for the construction costs actually incurred by him, a provision for the adjustment or revision of the price is not needed, except in respect of the fee, the ceiling, if any, on the total amount of reimbursable costs, or target costs.

A distinction is made in this paper between "adjustment" and "revision" of the price. Adjustment refers to cases where construction costs become higher or lower after entering into the contract due to a change in the construction required under the contract. This change may be due to a variation in the works to be constructed or a change in the method of construction from that anticipated at the time of entering into the contract due, for example, to incorrect data supplied by the owner, differing site conditions, or changes in local regulations and working conditions.

Revision of price refers to situations where the construction required under the contract remains the same, but certain economic factors have changed in such a way that the cost of the construction and the price to be paid for it have become substantially unbalanced. This may occur, for example, due to substantial change in prices of equipment, material or construction services or in tax regulations or tariffs after the contract has been entered into or due to a substantial change in exchange rates of the price currency in relation to other currencies. An adjustment or revision may increase or decrease the price, although experience shows that an increase is more common. It is advisable to limit adjustment and revision of the price to situations clearly determined in the contract or provided for by the law applicable to the contract.

The contract may provide for the price adjustment or revision to be determined in accordance with certain criteria specified in the contract. This approach is, in general, permissible under most legal systems. The contract might, for example, provide for price adjustment by reference to costs reasonably incurred by the contractor in specified circumstances. It might provide for price revision in accordance with a specified mathematical formula, or that allowance is to be made for costs reasonably incurred.

It may be inadvisable for the contract merely to obligate the parties to agree upon an adjustment or revision when stipulated circumstances arise since, if the parties fail to agree, difficulties may follow in settling the question in arbitral or judicial proceedings. The parties may further provide that, if disputes between them are being settled in arbitral or judicial proceedings, the tunnel construction is not to be interrupted during the proceedings. When the owner is a State or National enterprise, the parties should be aware that difficulties may be encountered in obtaining additional funds in cases of price adjustment or revision, or otherwise.

### **1. Adjustment of price**

The parties may wish to define carefully the circumstances in which the price determined in the contract is to be adjusted, so as to avoid uncertainty as to the price. In addition, a contract intended to be a lump sum contract may tend to take on the nature of a cost-reimbursable contract if adjustment is possible in too wide a range of circumstances. The contract might provide for an adjustment of the price when the construction under the contract is varied due to a recognized listing of circumstances, as follows:

#### *a. Incorrect data supplied*

The parties may wish to provide that the price is to be adjusted in cases where, as a result of incorrect data supplied by the owner, additional construction is required or a more expensive method of construction must be used in comparison with the method reasonably envisaged at the time of entering into the contract. However, the parties may wish to provide that the price is not to be adjusted if the contractor could reasonably have discovered the incorrectness of the data at the time of entering into the contract. The price adjustment might cover the reasonable costs of the additional construction or more expensive method of construction.

The parties may also wish to provide that, even in cases where the incorrectness of the data could not reasonably have been discovered at the time of entering into the contract, the price is not to be adjusted unless the contractor subsequently discovered the incorrectness of the data at the time it could reasonably have been discovered, and gave notification of the errors at that time to the owner.

The contractor might be expected to have inspected the site and its surroundings, to the extent practicable, before submitting a tender or negotiating a contract, and to have based his negotiations on the findings made during the inspection. During such an inspection, however, it may not be possible, even with reasonable efforts, to discover certain natural obstacles within the site, in particular subsurface conditions.

Different approaches may be adopted in the contract for cases where, during construction, natural obstacles, in particular, subsurface conditions, are encountered which could not reasonably have been discovered by the contractor during his inspection. The risk of such obstacles might be placed on the

contractor, and he might be obligated to bear the extra costs incurred as a result of the unforeseeable obstacles. An alternative approach might be to provide that the price is to be increased so as to reflect the higher costs reasonably incurred by the contractor due to natural obstacles encountered if they are called to the attention of the Engineer or the owner within a reasonable period of time after they could reasonably have been discovered. The parties may also consider the possibility of dividing the costs between them.

*b. Changes in Local Regulations and Conditions*

Certain legal rules of an administrative or other public nature in the owner's or the contractor's country may mandatorily regulate certain aspects of the methods of construction (e.g. in the interests of safety, or for environmental protection). If the construction to be effected does not accord with legal rules coming into force after the contract has been entered into, changes in the method of construction may be needed. The contract might specify who is to bear the risk of these changes. If the risk is to be borne by the owner, the contract might provide for the price to be adjusted. The contract may also provide for an adaptation of the price where supplies foreseen to be procured from local sources become unavailable and imports of those supplies from foreign sources of authorised.

## 2. Revision of price

Under most legal systems, the principal of "nominalism" governs the payment of a contract price: that is, the amount to be paid in the currency specified in the contract remains the same even if the value of that currency changes between the time of entering into the contract and the time the payment is made. The value of the currency may change in terms of its exchange rate in relation to other currencies. It may also change in terms of its purchasing power, with the result that the construction costs of the contractor may increase or, in exceptional cases, decrease.

Many long-term contracts contain clauses directed at reducing the exchange risk borne by the contractor. Such clauses may provide for revision of the price on the basis of indices or on the basis of costs actually incurred. However, contractual provisions concerning price revision due to a change in the value of the price currency are mandatorily regulated under some legal systems. The parties should, therefore, examine whether a clause which they intend to include in the contract is permitted under the law of the country of each party.

The contract might provide for the price revision clause to apply only in cases where its application would result in a revision exceeding a certain percentage of the price. The parties may wish to take into consideration that price revision clauses are not common where the duration of the construction as determined in the contract is less than 12 to 18 months from the coming into force of the contract.

*a. Change in the Cost of Construction—Index Clause Method*

The purpose of index clauses is to revise the contract price in accordance with changes in the costs of construction by linking the contract sum price to the levels of the prices of certain goods or services prevailing on a certain date. In tunnelling and other civil type contracts, the contract price may be linked to the levels of prices of materials or services needed for the construction of the tunnel. A change in the agreed indices automatically effects a change in the price, without the necessity of examining the actual prices paid by the contractor during construction.

Under the laws of some countries, the use of index clauses is not allowed or is restricted. For example, in some countries, index clauses are permitted only for the purpose of dealing with changes in construction costs occurring between the time the contract is entered into and its coming into force. An index clause may need to be adapted to a new situation in the event of a substantial revision of the scope of construction.

In drafting an index clause, it is advisable to use an algebraic formula to determine how changes in the specified indices are to be reflected in the price. Several indices, with different weightings given to each index, may be used in combination in order to reflect the proportion of different cost elements (e.g. materials or services) to the total cost of construction. Different indices reflecting the costs of different materials and services may be contained in a single formula. Different indices may be needed when the sources of the same cost element are in different countries.

Separate formulae, each with its own weightings, may be used for different aspects of the construction. If, for example, the construction involves a number of dissimilar types of operation, such as portal excavation, TBM procurement, tunnel construction, lining, adit construction, ventilation building construction, tunnel and building finishes, fan and pump installation and communications systems, a single price revision formula may be difficult to draft and may produce inaccurate results. In such a case, it may be preferable to have a separate formula for each main aspect of the construction.

An index clause may include a certain percentage of the price (commonly 5–20 percent) which is not subject to any revision under the clause. This percentage is intended to make allowance for the fact that some items may be paid for by the contractor at a lower price level than that reflected in the price index for those items. It may also afford some protection against other inaccuracies resulting from the formula used in the clause. In addition, if the aim of the index clause is to protect the contractor only against higher costs of construction and not against inflation in general, this percentage may reflect the contractor's profit.

The contract may provide that the index clause is to be applied to determine whether a price revision is needed at the time of each interim payment. In order to use the agreed indices, it is advisable to specify in the contract the date to be used as a basis for comparing the levels of the indices. The contract might provide that the base date is the date the contract was entered into. Alternatively, when the contract is entered into on the basis of tendering, the contract may provide that the base date is a specified number of days (e.g., 45 days) prior to the date of submission of the contract bid, or a specified number of days prior to the closing date for the submission of tenders, since the tender price may be based upon price levels existing at those times.

The contract might provide that the index levels on the base date are to be compared with the index levels existing a specified number of days prior to the last date of the period of construction with respect to which payment is to be made, since the costs will be incurred by the contractor before the end of this period. Alternatively, it might provide that the index levels on the base date are to be compared with the levels existing a specified number of days prior to the date on which payment is due. However, the contract

might also provide that if the contractor is in delay in completing the construction, the index levels existing a specified number of days prior to the agreed date for performance are to be used if those levels are more favourable for the owner. The ability of the owner to exercise the option might be limited to cases where the contractor is not prevented from performing in time due to exempting impediments.

Several factors may be relevant in choosing the indices to be used. The indices should be readily available (e.g., they should be published at regular intervals), and they should be reliable. Indices published by recognized bodies (such as well-established chambers of commerce) or by governmental or inter-governmental agencies may be selected. Where certain construction costs are to be incurred by the contractor in a particular country, it may be advisable to use the indices of that country with respect to those costs. The parties should exercise caution in using indices based on different currencies in a formula, as changes in the relationships between the currencies may affect the operation of the formula in unintended ways.

In some countries, particularly in developing countries, the range of indices available for use in an index clause may be limited. If an index is not available for a particular element of costs, the parties may wish to use an available index with respect to another element. It is advisable for an element to be chosen such that its price is likely to fluctuate in approximately the same proportions and at the same times as the actual material to be used (e.g., because it is composed of the same raw material, or can be used as an alternative to the actual material to be used). For example, in cases where it is desired to provide an index for labour costs, a consumer price index or cost of living index is sometimes used if there is no wage index available.

*b. Change in Costs of Construction—Documented Proof Method*

The contract might provide a method, often referred to as the documented proof method, to deal with change which may occur after the conclusion of the contract in the costs of certain specified elements connected with the construction. The documented proof method is based on the principle that the contractor is to be paid the amount by which his actual costs of construction, if they are reasonable, exceed the costs upon which the calculation of the contract price was based, due to changes other than changes in the quantity of materials, equipment and construction services needed for the construction.

The documented proof method therefore requires that the contract indicate the quantity and the price for each unit of the materials, equipment, and work upon which the calculation of the price was based. Revision of the price under this method would include the difference between the price reflected in the calculation and the price actually paid by the contractor for quantity units with respect to the quantity determined in the contract. In contrast to the cost-reimbursable pricing method, under the documented proof method the contract price should not be revised when the contractor incurs higher costs due to underestimation of the scope of his construction obligations at the time of contracting.

This method has certain disadvantages for the owner, since it imposes on him the risk of increases in construction costs due to the increases in the prices of equipment, materials and labour. In addition, the

ability to recover increases in his costs may give the contractor little incentive to keep down the costs of construction. The administrative procedures needed by the contractor to obtain documentary proof of the costs of construction and by the owner to verify such costs may be almost as extensive as the administrative procedures under a cost-reimbursable contract. For these reasons, the parties may wish to use the documented proof method only with respect to portions of the price calculated on the basis of unstable cost factors where the index clause method cannot be used (e.g., where relevant indices are not available).

If the parties wish to use the documented proof method, they should specify in the contract the portion of the price that is subject to revision under that method. It is advisable to identify in the contract the equipment, materials, or services with respect to which revision of the price is to take place, and to state separately the quantity and the amount of the costs relating to a unit of such equipment, materials or services upon which the contract price is to occur not only in the case of an increase, but also in the case of a decrease in costs. The contract might set forth procedures, similar to those which are to be used under a cost-reimbursable contract, by which the contractor is to prove the costs actually incurred by him. The contractor might require the contractor to purchase equipment or materials with respect to which price revision is permitted from approved sources, or after obtaining competitive bids.

*c. Relative Change in Currency—Currency Clause Method*

Under a currency clause, the price to be paid is linked to an exchange rate between the price currency and a certain other currency (referred to as "the reference currency") determined at the time of entering into the contract. If this rate of exchange has changed at the time of payment, the price to be paid is increased or reduced in such a way that the amount of the price in terms of the reference currency remains unchanged. For purposes of comparing exchange rates, it may be desirable to adopt the time of actual payment, rather than the time when the payment falls due. If the latter time is adopted, the contractor may suffer a loss if the owner delays in payment. Alternatively, the currency clause may give the contractor a choice between the exchange rate prevailing at the time when payment falls due or that prevailing at the time of actual payment. It is also advisable to specify an exchange rate prevailing at a particular place.

If a currency clause is to serve its purpose, the reference currency must be stable. The insecurity arising from the potential instability of a single reference currency may be reduced by reference to several currencies. The contract may determine an arithmetic average of the exchange rates between the price currency and several other specified currencies, and provide for revision of the price in accordance with changes in this average.

*d. Relative Change in Currency Exchange Rate—Unit of Account Clause Method*

If a unit of account clause is used, the price is denominated in a unit of account composed of cumulative proportions of a number of selected currencies. The unit of account may be one defined in an international treaty or by an international organisation, and which will specify the selected currencies making up the unit and the relative weighting given to each currency. In contrast to a currency clause, in which several currencies are used, the weighting given to

each selected currency of which the unit of account is composed is usually not the same. Greater weight is generally given to currencies commonly used in international trade.

The main advantage of using a unit of account as the currency unit with which the price currency is to be compared is that a unit of account is relatively stable, since the weakness of one currency of which the unit of account is composed is usually balanced by the strength of another currency. A unit of Account clause will therefore give substantial protection against changes in exchange rates of the price currency in relation to other currencies.

In choosing a unit of account to be used in a clause, the parties should consider whether the relation between the price currency and the unit of account can be easily determined at the relevant times, i.e., at the time of entering into the contract and at the time of actual payment. The unit of account defined by the International Monetary Fund as the Special Drawing Right (SDR) might be used. The parties might also refer to the European Currency Unit (ECU) as a unit of account. The values of these units of account in terms of a number of currencies are published daily.

#### **F. Payment Conditions**

Payment conditions in the contract may determine when and where various portions of the price are to be paid, and the modalities of payment. The time of payment may influence the price since the contractor may take into consideration interest in calculating the price. Payment conditions might provide an incentive for the contractor to perform in accordance with an agreed time schedule by providing for a substantial portion of the price to be paid to the contractor as various steps in the construction are completed. The place of payment may have important consequences. For example, while funds are being transferred to a different country, the value of currency may change. In addition, a transfer may be subject to foreign exchange restrictions. The modalities of payment (e.g., letter of credit or the documents supporting payment) may be structured so as to reduce the risk of the contractor not being paid on time and of the owner paying for construction not effected in accordance with the contract.

In drafting payment conditions, the parties should take into consideration the pricing method or methods used in the contract. If the lump-sum pricing method is used, the lump-sum price might be broken down and allocated against major aspects of the construction to be effected by the contractor (e.g. engineering, tunnel driving, supply of equipment, or transfer of technology). The portions of the price with respect to such major items may be allocated to the supply and setup of a TBM. A certain percentage of that allocation might be payable in advance, a certain percentage during construction, a certain percentage after completion of tunnel driving.

If the cost-reimbursable pricing method is used for the contract or a portion of the total construction, the contract might contain an estimate of the costs of construction covered by that method. A specified percentage of the total estimated reimbursable costs might be payable in advance, a specified percentage of the costs incurred during construction might be payable within a specified short period of time after receipt by the owner of cost back-up required under the contract, a specified percentage of those costs might be payable after takeover or acceptance of the project, and the rest might be payable after expiry of any warranties or the guarantee period. In agreeing upon the time when the fee is to be paid to the contractor, the parties should take into consideration the nature of the fee

*"In agreeing upon the time when the fee is to be paid to the contractor, the parties should take into consideration the nature of the fee to be paid. A certain portion of the fee may be payable as portions of the construction are completed, a certain portion after acceptance, and the rest after the expiry of any guarantee periods."*

to be paid. A certain portion of the fee may be payable as portions of the construction are completed, a certain portion after acceptance, and the rest after the expiry of any guarantee periods.

If the unit price method is adopted, the contract might provide that a specified percentage of the estimated price, calculated on the basis of estimated quantity of construction covered by this pricing method, is to be paid in advance, a specified percentage of the price with respect to the construction as actually effected is to be paid at the times specified in the contract, a specified percentage of the price with respect to that construction is to be paid after takeover or acceptance and the rest after the expiry of any guarantee periods.

#### **1. Advance payment**

An advance payment might be required under the contract to cover the contractor's working capital and expenses in the initial stages of the construction (e.g., for initial purchases of a TBM, other equipment and materials, or transport and accommodation of personnel). An advance payment may also provide the contractor with some protection against loss in the event of a termination of the contract by the owner prior the commencement or at an early stage of construction. The owner might be protected by a guarantee against failure by the contractor to repay the advance. The amount of the advance payment could be calculated so as to cover the initial expenses of the contractor which are anticipated. The contract might require the advance payment be directly remitted by the owner to a bank designated by the contractor within a specified period of time after the provision by the contractor of any performance and repayment guarantees.

#### **2. Payment during construction**

It is advisable to provide in the contract for the payment of portions of the price as the construction progresses. The amount to be paid during construction should be determined taking into consideration the nature of the construction to be effected and the pricing method adopted.

One approach to determining the time and extent of payment may be to identify specific portions of the construction (e.g. shaft construction, portal excavation, pilot tunnel completion, air plant setup) and to provide that specified portions of the price are to be payable upon completion of those portions. An alternative approach may be to provide that the contractor is entitled to receive progress payments for the construction completed within specified periods of time (e.g. every month), the amount of the payment depending upon the extent of construction effected within that period.

Equipment and materials supplied by the contractor may be paid for after they are incorporated into the works,

under either of the approaches described in the preceding paragraph. The parties may, however, agree on another approach, particularly in cases where the equipment and materials are taken over by the owner after their delivery, and are in his physical possession until their use for construction. In these cases, the portion of the price with respect to such equipment and materials may be payable against the submission to the owner or the owner's bank of documents proving that they have been handed over to the first carrier for transmission to the owner and insurance has been taken out, or that they have been handed over to the Engineer, on the site.

It is advisable to specify in the contract the documents which the contractor is obligated to submit in order to obtain payment, such as invoices, bills of lading, certificates of origin, packing lists, and inspection certificates. The documents to be required may depend upon the time and manner of performance. Differing documents may be required with respect to supplies of equipment, materials or services. The documents required may also differ depending on the method of pricing used by the parties.

Since payments during the construction process are to be effected with respect to construction already completed, the parties should clearly agree upon the procedures for determining such completion. The owner may wish to authorize the Engineer to measure the extent of the completed construction. To obtain a progress payment, the contract might require the contractor to submit to the Engineer at the end of each payment period certain documents supported by a detailed report concerning the construction completed in the relevant payment period. The contract might provide for payments to be effected on the basis of interim certificates issued by the Engineer or the owner.

If the cost-reimbursable pricing method is used, special contractual provisions may be needed for the verification of costs incurred by the contractor. The contract might entitle the contractor to payment of a portion of the price with respect to subcontracted construction only if he has already paid his subcontractor, or if the payment to the subcontractor has at least become due. The owner may be able to influence payment conditions in subcontracts by participating in the selection of the subcontractors or by including in the prime contract requirements for payment conditions in subcontracts.

The contract might specify a period of time within which an interim certificate for payment must be issued by the Engineer or the owner, and a period of time after issuance of this certificate within which payment must be effected by the owner. The portion of the price under the certificate might be made due within a specified period of time after submission of the certificate to a bank to be specified in the contract. In case of failure to issue the certificate even though the event entitling the contractor to payment has occurred, or to pay the amount due under the certificate, the contractor might be entitled to claim payment in dispute settlement proceedings.

### **3. Payment within specified time after takeover or acceptances**

Certain percentages of some portions of the price (e.g., those with respect to equipment and material supplied, engineering, installation, or transfer of technology) might be payable only upon proof that construction has been successfully completed, i.e., after acceptance of the works. The contract might require the owner to pay those portions of the price within a specified period of time after such proof (e.g., within two weeks after successful performance tests have been conducted, or an acceptances protocol has been signed). In some cases, where take over precedes acceptance of the works, a portion of the price might be made payable within a specified period of time after takeover.

### **4. Payment within specified time after expiration of a guarantee period**

Where the scope of project includes the installation of industrial equipment necessary for the operation of the constructed tunnel or other underground facility, the contract may provide for a guarantee period. To protect the owner against the consequences of defective construction by the contractor, the contract might provide that a certain percentage of the price is payable only within a specified period of time after expiration of the guarantee period.

In fixing the percentage, the parties may wish to take into account the other securities which are available to the owner in case of the discovery of defects during the guarantee period. If the owner is sufficiently protected by a performance guarantee or bond, the contract might provide that the entire price is to be paid within a specified period of time after the date of the acceptance of the works.

The contract might further provide that if any defects are discovered and notified within the guarantee period, the owner is entitled to retain from the portion of the price then outstanding an amount which is needed to compensate him for the defects. The retention might last until the contractor cures the defects and pays any damages to which the owner may be entitled.

### **5. Credit granted by contractor or contractor's country**

In most cases, the construction of a tunnel is financed by a loan granted to the owner by a national treasury or a financing institution. However, in some cases, where the contractor has at his disposal ample financial resources and the project is not large, the contractor may prefer to grant a credit to the owner with respect to a portion of the price. In such cases, the portion of the price covered by the credit might be repayable in installments within a specified period of time after takeover or acceptance of the tunnel by the owner.

Where the contractor grants such a credit to the owner, some of the same issues which are dealt with in a loan agreement with a financing institution (e.g., security for repayment of the loan by the borrower and interest payable on the loan) must also be settled between the owner and the contractor.

The construction of a tunnel is sometimes financed by a credit granted by the contractor's country to the owner's country. In these cases, the parties should, when drafting

*"There is no standard or preferred method of contracting for tunnelling projects. The owner may want to choose Design-Bid-Build, Design-Build or some combination thereof, in relation to the nature of his own capacities and the project at hand. However, the nature of tunnelling is such that the owner should consider the prior experience and technical capacity of the contractor to be offoremost importance. Such experience and know-how should by no means be sacrificed for a low price or convenient financing."*

*"The ITA recommends the use of milestone events based on a short time frame in order to provide the contractor with sufficient working capital."*

the payment conditions in the contract, take into consideration the provisions of the agreement between the governments of these two countries and the rules which may be issued in the owner's country in connection with the implementation of the agreement (e.g., conditions under which the credit may be used for construction).

## 9. Conclusion

When drafting a construction contract which will include tunnelling works, the owner will need to choose a method of contracting and price and payment provisions which take into consideration the particularities of underground construction.

### Contracting Methods

There is no standard or preferred method of contracting for tunnelling projects. The owner may want to choose design-bid-build, design-build or some combination thereof, in relation to the nature of his own capacities and the project at hand. However, the nature of tunnelling is such that the owner should consider the prior experience and technical capacity of the contractor to be of foremost importance. Such experience and know-how should by no means be sacrificed for a low price or convenient financing.

The coordination mechanism, be it the owner's engineer, a contractor, or a management contractor, should be similarly experienced and knowledgeable in the area of underground construction in order to ensure the proper management of all project interfaces and in particular the interfaces between tunnelling work and other work to be

performed under the contract. Special attention will need be given to effects of tunnelling work on surrounds and the potential hazards of slowdowns or suspension of underground work.

Just as the owner should consider such risks and experience, contractors bidding for projects including tunnelling works should consider their own construction and coordination abilities in the area of underground construction. This is of particular importance in creating a consortium or joint venture in order to provide a project vehicle, particularly where the members will be held jointly and severally liable. The contractors involved will need to ensure that the group includes a member with the experience necessary for the tunnelling works envisioned.

### Pricing and Payment

As mentioned above, the owner will want to implement payment conditions that maximise the contractor's incentive to early, efficient and effective progress. The ITA recommends the use of milestone events based on a short time frame in order to provide the contractor with sufficient working capital.

When pricing tunnelling works, the ITA recommends use of unit prices. Cost-plus pricing is generally impractical for tunnelling while the nature of tunnelling work and the uncertainties of subsurface conditions may mitigate against the use of a lump-sum price.

In tunnelling contracts using unit pricing, the system of measurement must take into consideration the cost of excavation of differing soil types. The units for tunnelling should be based on a measurement regime using distinct sets of geological conditions, restricted to no more than five classes bounded by upper and lower limits that do not overlap. For each rock class, excavation and filling of overbreak should be measured per unit area of specified excavation surface. □

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