

# **EXPERIENCE WITHIN THE CERN CIVIL ENGINEERING GROUP WITH OUTSOURCED DESIGN SERVICES**

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## **Abstract**

In April 1996, CERN awarded three contracts for civil engineering design services associated with the LHC project. The three contracts were awarded to three different joint ventures of firms from five member states. The total bid price for these services was in excess of 35 MCHF and the contracts will run for up to seven years. This paper aims to discuss and analyze the experience gained to date in the management of these contracts. In particular, the paper will address the issues of conditions of contract and specification for this form of contract. Current experience with each of the three consultants will be presented with the areas of difficulty highlighted. Conclusions will be made regarding future use of such contracts and in particular the way in which CERN must change in order to work efficiently with external designers.

## **1. INTRODUCTION**

Over the last decade and under increasing financial pressure from member states, CERN has reduced the number of staff by around 18% and expects to reduce it by a further 33% over the next ten years. In the Civil Engineering Group, the staff level has dropped by around 65% in the last six years alone.

In the Civil Engineering Group, this ongoing staff reduction has been accompanied over the last three years by a substantially increased workload, namely the civil engineering required for the Large Hadron Collider (LHC) project. From the outset, it was clear that it would be impossible to undertake such a large and technically demanding project without either significant additional recruitment or assistance from external consultants. The latter option was chosen for several technical reasons as well as the need to adopt the global CERN policy of outsourcing services wherever possible.

## **2. TECHNICAL REASONS FOR OUTSOURCING DESIGN SERVICES**

One of the most compelling reasons for outsourcing of design work for a large and complex project such as the LHC is that the range of skills required to carry out the design, production of tender and construction documents is large. For example, for the design of large caverns, the use of specialized computer software and operators is required, normally for a relatively short timescale and on an intermittent basis. Clearly, it would not be economical to purchase and permanently employ the resources required for this kind of operation for a one off medium sized civil engineering project such as the LHC. In the domain of civil engineering, and in particular the underground structures, the LHC can be considered as a fairly unique project, pushing the boundaries of current practice; but it is none the less within the capabilities of a number of design firms with relevant experience. This experience has of course been built up over several tens of years and cannot be substituted by a “one off” team put together for one project. Another major reason why outsourcing may be seen as beneficial in certain cases is the very large pool of resources that can be utilized at short notice and from which a

large database of knowledge is available. For example, the average number of people working for one of the consultants was 35. This number peaked during the production of the tender documents at over 60, and at times could have been as low as five. Clearly, a large consultancy firm can accommodate such fluctuations since they always have several ongoing projects from and to which resources can be allocated.

From a cost point of view and making a simplified comparison, the average hourly fees charged by the external consultants for a senior engineer are about the same as CERN pays for an equivalent person. However, the external cost includes the management overheads, secretaries, printing costs, office rental and maintenance, computer and software purchase, etc., which the CERN cost does not.

### **3. THE CONSULTANCY CONTRACTS**

#### **3.1 Introduction**

The LHC civil engineering has been divided into three packages with each package awarded to a joint venture of two or three consultancy firms. The three contracts were awarded in April 1996 following the Finance Committee of March 1996.

The basis for the contracts was a fixed price for five separate phases of work. The first phase was termed the preliminary design phase during which the consultants studied the feasibility of the CERN layouts and produced outline drawings. The second was the tender design phase at the end of which the consultants had to produce all the technical documents required for the call for tender for the construction contracts. The third was the construction design phase during which the consultants produced all the drawings and documents necessary for construction. Phases IV and V are for the supervision of the construction works where the consultants will maintain a small team on site.

One of the most difficult features of writing a contract for intellectual services is in defining the scope of works since the deliverables are simply a few drawings and documents; yet, because the intellectual input is high, the costs can be disproportionate to the output. As is normal with these contracts, the main contractual clause dealing with this issue requires the consultants simply to perform the services with: *“all such reasonable skill, care and diligence, as may be expected of a properly qualified and competent civil engineer experienced in carrying out work of a similar size, scope and complexity”*.

In addition, there are of course many other clauses dealing with such subjects as payment mechanisms, program, penalties for delay, cancellation of the project, insurances, guarantees, dealing with variations, etc. Some of the more important of these are discussed in the following sections.

#### **3.2 Payment Mechanism**

The payment mechanism is such that the design services are a fixed lump sum price for phase I and a negotiated (on the basis of the phase I design) lump sum price for phases II and III subject to a price revision formulae based on indices in the payment currency. In addition to these lump sum prices, payment for additional services are also included in the contract, for example: assistance in selection of contractors, meetings, design reviews of other consultants, etc. The basic aim of the payment mechanism has been to enable CERN to have the major part of the services as a fixed price, but retaining the flexibility to have additional services and variations where required.

#### **3.3 Programme**

There are several clauses intended to ensure that the contractor and CERN carry out their contractual obligations on time. For instance the contractor must furnish all deliverables (reports, drawings etc.) by certain milestone dates. In Package 02 for example the consultant has a penalty of about 3000 Swiss Francs per day and per deliverable up to a limit of 150,000 Swiss francs. Although to date

CERN has not been required to use these penalties, the threat of them has been used in bargaining other issues such as delays on the part of CERN. CERN too has certain contractual obligations such as approving drawings and documents within certain pre-defined times. Failure to do so has led to extensions of time for the contractor and could even lead to increased costs to CERN.

### **3.4 Insurance and Guarantees**

The contracts require the consultants to maintain Professional Indemnity (PI) insurance and Third Party Liability Insurance for 10 Million Swiss Francs for each and every event. This level of insurance is quite high and is really applicable for this size and duration of contract only. A performance guarantee is required from the consultants for the sum of 600,000 Swiss Francs to ensure the proper performance of the services by the consultant.

### **3.5 Variations**

Under the contract, CERN can order any variations which must be carried out by the consultant. The prices for such variations are negotiated but based on the unit prices given in the contract. The contract requires the consultant to declare the impact (time and cost) of a variation before carrying out the associated work. Control of variations through contract clauses is an important aspect when it is considered that for the three consultancy packages, the variations instructed during phases II and III will amount to around 30% of the total contract sum for these two phases.

## **4. CERN EXPERIENCE IN THE CONTRACT MANAGEMENT**

### **4.1 Introduction**

To date, the CERN experience in managing the three contracts has been generally satisfactory and the documents required from the consultants for the calls for tender were all received within the foreseen contractual deadlines. In some areas, however, problems have occurred and these are discussed below.

### **4.2 Contract Draughting**

One of the first problems was in completing the conditions of contract with each of the three consultants. The main difficulty was that only an outline set of conditions was included with the call for tender documents and tough negotiations were required once approval from Finance Committee had been obtained. This was particularly true for package 03 where it was over one year after the consultants started working before the contract was signed. The development of the contract documents was a long process involving CERN staff from the CE Group, the Legal Service, the LHC Division Leader's office, Purchasing as well as External Legal Counsel. A strong recommendation for the future is to ensure that all contractual documents are produced prior to, and included in, the calls for tender.

### **4.3 Consistency of Consultants Deliverables**

Another problem has been in achieving consistency in the drawings and documents produced by the external consultants. Unfortunately, all three consultants have been very reluctant to work or liaise with the other consultants, and this has led to some additional expenditure on the part of CERN in order to achieve consistent tender documents for the construction contracts. Unfortunately, it is difficult to foresee a different situation since the consultants have all different national systems of working, and it is politically difficult to impose one system on all the consultants regardless of their nationality. CERN attempted to impose European or other international norms wherever possible but in many technical areas these do not exist.

#### **4.4 CERN Internal Project Management**

Probably, the largest problem has been adapting the internal system of working at CERN in order to work successfully with the external consultants. For example, contractually, CERN should provide information to the consultants by given dates, but CERN has quite often been delayed due to lack of information from other groups. It is considered that this problem is due mainly to the weak internal planning that existed until recently and also the historical way of working whereby changes could be accommodated even at the last minute without any apparent cost influence. There has been, within CERN, some surprise when the consultants claim additional costs for incorporation of changes or additions to their scope of works. Unfortunately, when competitive tendering is used to obtain fixed prices, it is normal that the bidders put in the absolute minimum bid in order to be successful in obtaining the contract. Of course, this leads to claims at every possible opportunity. Although in many respects these claims are an inevitable consequence of having to carry out the civil engineering well in advance of the equipment installation, it is considered that the claims and therefore the cost of the civil engineering design could be reduced through better initial planning and coordination.

### **5. CONCLUSIONS ON THE USE OF EXTERNAL DESIGN CONSULTANTS**

The use of external design consultants for the LHC civil engineering contracts can to date be considered a success since the designs are almost complete and the contracts for the construction works themselves ready to be signed. Apart from the probable cost saving made through the use of external consultants, there is no doubt that CERN could not have mobilized a design team and carried out the detailed design and production of tender documents in the very short time that was available. Whilst they have been successful on the large scale LHC project, it is doubtful that benefits of using outsourced consultants would outweigh the disadvantages when dealing with smaller contracts or feasibility studies. Their use can be recommended where the scope of services is large, can be very clearly defined, and the project is at an advanced stage.

One of the most important requirements in considering using external consultants is to ensure that the contract documents are clearly defined before tendering and that they are included with the tender documents. All possible scopes of work should be included because it is very difficult later to negotiate a competitive fee even when the unit rates are known and fixed.

The use of external consultants does require a review of CERN's internal work methods. The traditional way of working in groups with specific activities (CE, CV, IE, etc.) does not lend itself well to fast track design with external consultants where design information is required rapidly. For these projects, it may be beneficial if a specific team is set up working very closely together. Such a team, for say the Point 5 area, could be set up with, for instance, a civil engineer, a cooling and ventilation engineer, etc. This would enable more rapid and efficient transfer of information and probably help to reduce the number of changes required.

Most importantly of all, it is necessary for a detailed planning to be set up from the outset of the project to ensure that all people working know clearly their objectives and target dates, not only for their own sphere of working, but also for others working on the project. This aspect is always important but especially so when working with external consultants where unnecessary delays and changes are simply wasted money.