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### **INTRODUCTION OF A TARGET COST MECHANISM IN ONE OF THE LHC CIVIL ENGINEERING CONTRACTS**

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#### **Abstract**

Since February 1997 when the four main engineering contracts were issued to prospective bidders there have been many changes to the CERN requirements associated with civil engineering. The contract associated with the LHC machine (T054) has been the one most disrupted by these changes, many of which have come about as a result of the later than anticipated delivery of the Déclaration d'Utilité Publique (DUP) from the French Government. This has led to all contractual dates being changed and significant acceleration of the works being instructed. This paper discusses a mechanism that has been introduced into the contract that enables all parties to work together in order to minimise the cost of these changes. The mechanism, which is based on a Target Cost, enables the contractor to obtain financial benefit from reducing the overall cost to CERN.

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## **1 INTRODUCTION**

In July 1998, CERN entered into contract for the provision of civil engineering construction works associated with the LHC Project with a joint venture of three contracting firms, Taylor Woodrow (UK), Spie Batignolles (F) and Amec (UK). The contract was signed six months later than foreseen at the call for tender due to a delay in the delivery from the French government of the Déclaration d'utilité Publique (DUP). The contract was based on the call for tender which had been drawn up in early 1997. The contract contained over forty planning dates. These dates were generally completion dates to be respected by the contractor or dates for access to the existing CERN facilities which needed to be respected by CERN. The access dates were based on SPS and LEP running schedules as well as LEP dismantling and LHC installation schedules as known in February 1997.

At the time of entering into contract with the contractor, it was clear that substantial revisions to the contractors planning would be required in order to conform with the CERN schedules were constantly being updated as the LHC project developed. The most serious problem was the construction of the TI2 injection tunnel which had one particular constraint namely the need to do all work in the SPS radiation limit within a strictly defined time window during the normal SPS shutdown periods. Unfortunately, due to the six month delay in the commencement of the project, the contractors planning was no longer compatible with the SPS schedule. CERN was forced therefore to instruct the contractor to commence construction of the tunnel towards the SPS rather than the LEP as he had originally planned.

## **2 MAJOR PROJECT CHANGES**

As the project progressed, more and more events arose which required major planning changes and increased resource levels. Some examples of these changes are listed below.

- The introduction into the contract of the SMA18 building (5 MCHF)
- The total revision of the planning for the SHM buildings and SD buildings to take account of new LHC planning relating to the installation of the cryogenics plant.
- Revision of the access routes and land availability for the contractor. In particular the available areas for the contractors installations were significantly reduced.
- Increased restrictions by CERN on the contractors planning including major reductions in the time available for the contractor to carry out the work.
- Increased amount of works (25% increase in the size of SHM buildings for example).
- Worst than expected geological conditions encountered.
- Revision of the position of the TI2 tunnel.
- The introduction of a 35 hour working week in France.

These changes had a significant impact on all aspects of the contract in particular the contractors planning and resourcing. At the time of tender the contractor had intended to use one main team for the surface works and a second team for the underground excavation works. The many changes made this impossible. Taking the example of the beam dump civil engineering works, the contractor had intended to use one excavation team to carry out all the works within the allowable timescale. Following layout, design and planning changes, the works can only be carried out with a least four teams requiring substantially greater costs.

## **3 CONTRACT MANAGEMENT**

The original contract was based on the standard, internationally used FIDIC "red book". This standard contract includes clauses dealing with the normal changes expected to occur in a civil engineering contract. Unfortunately it is not so well adapted to cope with the large number of changes that have arisen in this case. The FIDIC red book assumes the project to be reasonably well defined prior to contract signature and that the contractors unit prices (based on the information provided by CERN at

the time of tender) remain valid during the contract. Clearly with so many changes as have occurred in this case, the contractor has easily been able to demonstrate that his original tender prices can no longer be valid and that new rates are required. The determination of new rates, which, following proposals from the contractor, is carried out by the consultant Engineer (in this case a joint venture of Brown and Root from the UK and Intecsa from Spain), is a difficult process that inevitably leads to disagreement and dispute.

Due to the complexity of the process of producing unit rates from base costs, it became impossible, using the existing contract, to determine the correct cost of carrying out the project. It was soon evident that an alternative method of evaluating and making payments needed to be found.

A second problem that arose in trying to implement the FIDIC contract when faced with such fundamental changes was that of contractor involvement in decisions relating to design and construction techniques. Under FIDIC, the contractor is expected to carry out the construction work in accordance with the drawings, specifications, planning etc as was presented to the contractor when he compiled his offer.

In this case, when the original basis of the offer was no longer valid and CERN was faced with decisions to make on planning and resourcing issues, the contractor was not willing to provide input to find the best solution to the problems. His attitude was simply “tell me what to do and I will tell you later how much it will cost”. Clearly such a situation is far from ideal since information known only to the contractor could be crucial in ensuring that correct decisions are made.

Once again it was apparent that a new way of carrying out the contract management was required in order that the contractor could be incentivised to participate in the decision making process which would assist in minimizing the effect, in terms of time and money, of the changes and modifications.

To summarize the requirements, the contract needed to be changed from one whereby the contractor endeavours to benefit from changes by increasing project costs as much as possible (since his profit is a percentage of turnover) to one whereby the contractor could benefit from lowering the cost of the project. If the contract could be successfully modified to achieve these goals then there would be a chance to maintain control over a contract that was becoming increasingly unworkable.

#### **4 THE SUPPLEMENTAL AGREEMENT**

In October 1999 the first meeting took place between CERN and directors from the three companies in the contractor's joint venture. During this first meeting it became apparent that the only way to achieve the goals set out above was to enter into some form of agreement that would work within the existing contract mechanism. The main purpose of the new agreement would be to modify the payment procedure such that the contractor would be paid “at cost” plus some kind of bonus if the work was performed at a lower cost than some pre-determined target.

Over the following months, several more meetings took place and the basic principles of the agreement were determined. These were:

- A Target Cost would be established against which actual costs would be measured. Any positive savings in the difference between the actual costs and the Target Cost would be split 70:30 in favour of CERN.
- The Target Cost would be established based on CERN's technical and planning requirements as known in December 1999. The Target Cost would be built up using the rates, prices and principles that the contractor had used to price the original contract. The contractor would build up the cost from first principles that is to say from labour, plant and material rates as used in the original contract.
- The contractor, CERN and the consultant engineer would strive to make savings against the Target Cost through the process of value engineering.

- Payments would be made by CERN to the Contractor on the basis of a predetermined cash flow established from the Target Programme. All costs incurred by the contractor would be verified in the following month(s).
- The contractors profit and overhead related to the Target Cost (being 12% of the Target Cost) would be frozen and not subject to change regardless of any savings made against the Target Cost.
- Any disputes arising would first be investigated by a Project Board consisting of three senior people from CERN and three directors from the contractor. Disputes not settled by the board would follow that normal contract mechanism of an adjudication panel.

Once these basic principles were agreed, it took many months of further discussion and negotiation to establish and agree the details of the agreement. One of the main issues that took a long time to resolve was that of the contribution to cost by the contractor in the event that the actual costs exceeded the Target Cost. Another problem internal to CERN was how to ensure that the agreement did not go beyond the internal purchasing regulations. Eventually a meeting of CERN division leaders and directors held in early 2000 concluded unanimously to go ahead with the agreement as it was considered to be the best way of ensuring the contract progressed and costs minimized.

## **5 THE PAYMENT MECHANISM**

The supplementary agreement contains much detail but in essence is a document that sets out how the works are measured and how the contractor will be paid. The details are as follows:

A Target Programme is established based on a set of known CERN requirements and the principles used at the time of tendering by the contractor. From this Target Programme a Target Cost is established also using the same principles as used by the contractor when making his original tender offer.

The Target Cost is expressed as a cash flow based on the Target Programme. The cash flow is used for establishing the monthly payments to the contractor. All the contractors costs (labour plant and material) must be fully justified through the presentation to the consultancy engineer of invoices, pay slips etc. In addition CERN has the right to carry out an audit of the contractors accounts.

At the end of the project the actual costs and the amended Target Cost will be established. In the event where the actual costs turn out to be higher than the Target Cost by up to two million CHF, the contractor will be penalised through the loss of any profit and overhead. In the event that the difference between Target and actual costs is greater than 2 Million CHF then the contractor will have to contribute 30% of the difference up to a ceiling of 5 Million CHF.

At the end of each year, an interim assessment of actual costs against Target Cost will be made and an interim payment made to or deducted from the contractor.

Since, even at the time of draughting the agreement further changes by CERN were envisaged to be likely, it was necessary to ensure that a mechanism was in place that allowed the Target Cost to go up (or down) when changes to CERN requirements occurred. These changes will be costed using the same principles as used to establish the initial Target Cost.

## **6 THE AGREEMENT IN PRACTICE**

The agreement was completed in June 2000 although final signature did not occur until September 2000. The agreement applies only to the underground works and as such its conditions apply from the beginning of tunneling works for the TI2 that is to say from the 28 June 1999.

It took several months to put the agreement into practice and the payment for the month of October 2000 was the first to be based on the agreement.

Since the agreement was put in place there has been a clear effort from all three parties to carry out the works in the most cost efficient manner possible. Whereas prior to the agreement the contractor would not take part in decision-making processes, he is now far more active in helping find

the most cost efficient ways of carrying out the work. Prior to the agreement, it would have been impossible for the CERN planners to have a cooperative discussion with the contractors planning staff simply because the contractor sole purpose would be to maximise the apparent disruption caused by any changes arising from changes caused by CERN. The contractor was not obliged to provide any positive input to such discussions. Since the agreement, this has changed and the contractor has already been involved in several LHC planning meetings because now all parties have a benefit of lowering overall costs. It also helps CERN greatly since we can now make balanced judgements based on information provided by the contractor. Information that, prior to the agreement he would not have provided.

The process of looking at the existing CERN requirements and seeing if they can be improved upon is undertaken through a series of “value engineering” workshops. Two such workshops have already taken place. The first workshop looked at the junction between the beam dumps and the LHC tunnel. The workshop has produced several options for CERN to look at with potential savings of over 1 Million CHF. The second workshop looked at ways of improving the layout and design of the junction between the TI2 tunnel and the LHC tunnel, again options have been drawn up which not only will be cheaper for CERN but will also have significant benefits in terms of final use. Other area’s are planned to be looked at in future workshops and it is hoped that the civil engineering costs can be reduced further.

Although the implementation of the agreement has certainly had positive benefits to the project, there are still aspects, which lead to confrontation between CERN and the contractor. This problem stems from the inevitable consequence of the fact that the contractor, although benefiting from lower actual costs, also benefits from increasing the Target Cost as high as possible. By increasing the difference between actual costs and target cost he can maximise his profit. At times therefore it is clear that rather than concentrating his efforts on minimizing costs; the contractor appears to be more interested in seeing how he can increase the Target Cost. This has caused some friction between the parties, which makes it more difficult to maintain the spirit of cooperation, which is the basis of the supplemental agreement.

## **7 CONCLUSIONS**

After one year of discussion and negotiation, the supplemental agreement was finally signed and implemented in September 2000. Some positive benefits have already been seen to arise from the agreement and it is hoped that these shall increase as the project continues.

Despite these benefits, the spirit of trust and understanding that is crucial to the success of the agreement is not yet 100% evident. It is hoped that this situation will improve in order that this contract which has been subject of numerous changes by CERN can turn out to be one of the most successful of the four contracts currently being implemented for the LHC civil engineering. It is certainly evident that the use of the Target Cost mechanism through the supplemental agreement is very likely to lead to significantly lower overall costs to CERN than had the original contract been pursued.

Although the use of this kind of Target Cost mechanism should be limited to extreme situations where the original contract becomes unworkable, similar types of contracts have been utilised successfully on other projects from the start of the project. It would be beneficial to avoid a Target Cost that can be moved. In this way the client could benefit from having an upper limit on his exposure whilst retaining the benefits of value engineering. In the case of CERN it is difficult to see how such a contract could be implemented within the current restrictions of the purchasing regulations which advocate transparency before value.