Cost Control of Sub-contracted Projects Based on EPC Petrochemical Engineering

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Abstract. EPC model is one kind of scientific and efficient petrochemical engineering management at present in our country. The EPC general contractor should effectively control the cost of sub-contracted construction projects, in the process of EPC petrochemical engineering construction. The aim is to rational use of the limited resources including human, funds and material resources, to obtain greater economic effects and social benefits for the EPC general contractor. The paper studies some impact factors of the sub-contracted projects based on EPC petrochemical engineering. And corresponding solutions are put forward in the paper, such as paying more attention subcontract management, advocating strict control of direct expense, optimizing construction scheme, and so on. Through the above analysis, some references are hoped to provide some advantages of the cost control of sub-contracted projects for the EPC petrochemical engineering general contractor.

Keywords: Cost Control, Sub-Contracted Project, EPC Petrochemical Engineering

1. Introduction
As EPC general contract model is widespread in the Europe and America and other developed countries, it is gradually promoted in China for integrating with the international practice, especially energy and chemical engineering, for example, petrochemical engineering[1]. EPC petrochemical engineering tend to have a large scale, it is not possible to complete all projects independently because of some restrictive factors. So the EPC energy engineering general contractor usually has numerous cooperative units, for example subcontractors. On the premise of ensuring period and quality, EPC petrochemical engineering can achieve the target of maximum economic benefits by subletting the contract. The cost control of sub-contracted projects is an important part of the EPC energy engineering. The effective cost control of sub-contracted projects plays an important role in the target achievement of EPC petrochemical engineering.

2. Some Relevant Theoretical Foundations about the Cost Control of Sub-contracted Projects for the EPC Petrochemical Engineering
2.1. The Connotation of EPC Engineering

EPC engineering has so much difference from conventional project. EPC is abbreviation form of the English name for “Engineering Procurement Construction”, means: The EPC general contractor should undertake liabilities of design, construction and procurement in accordance with the contract, run engineering quality, construction safety, construction period and cost, finally provide the owner with the project which has compliance with the requirements of the contract, using conditions, completion acceptance[3]. In EPC engineering, the EPC general contractor is central role, should have the professionalism and professional competencies. For example, the EPC general contractor should have strong organization and coordination and management capacity, command subcontractors capacity during construction, etc. It is very important for the EPC general contractor to effectively control subcontractors in every aspect, especially cost of sub-contracted projects[3].

2.2. The Connotation of Sub-Contracted Project

The sub-contracted project is contract pattern. Because the EPC general contractor is often subject to resource limitations or urgent project duration, or other reasons, it subcontracts some of own contracted works to subcontractors in that case. The subcontractors often have a higher degree of specialization, increasingly managerial and technical level and good market reputation. The general contractor select such subcontractors to fill the gaps, should effective control such subcontractors, which is support for the successful completion of the projects[4].

2.3. The Connotation of Project Cost Control

Project cost control is that all expenses of project is strictly controlled within the contract stipulates, so the contractor can optimize use of resources, including human, funds and material resources to fulfill the construction goals and have a higher profits. Project cost control is a comprehensive and systematic work, which concerns many reasons in the engineering construction. So such reasons should be completely analyzed and found out the feasible control methods[5].

3. The Influences on the Cost of Sub-contracted Work Based on EPC Petrochemical Engineering

3.1. The Management of the Sub-Contract in EPC Petrochemical Engineering

(1) The Selection of subcontractors. In EPC petrochemical engineering, sub-contracted works are finished by subcontractors. Selecting qualified subcontractors directly relates to the quality of construction project, the fast or slow construction schedule, the occurrence of project unsafe events, the professionalism of construction management, the credibility of the EPC general contractor, etc. The above points directly affect the cost control of sub-contracted works based on EPC model. So the EPC petrochemical engineering general contractor has to be careful on selecting qualified subcontractors[6].

(2) Signing of sub-contract. The EPC petrochemical engineering general contractor should investigate the subcontractor's qualification and reputation before the signing of subcontract. The investigating of the subcontractor's qualification and reputation is important prerequisites for the successful completion of the subcontract works. In the qualification and reputation investigation, there are always some construction teams borrowing qualification of construction or business license. (3) The implementation of sub-contract. Whether the sub-contract is performed according to the stipulation in EPC petrochemical engineering, it is related to the each phase. Whether the scope and period of sub-contract projects are performed according to the stipulation, it is related to the engineering cost. If the sub-contracts get effective management during construction, EPC general contractor and subcontractors reduce their disagreements as possible, it is beneficial to the EPC petrochemical engineering cost.

3.2. The Direct Fee of Sub-Contract Project Based on EPC Petrochemical Engineering

(1) The labor cost. The labor cost is to pay for workers who completes construction and installation tasks during sub-contract project construction. The labor cost roughly take up 20 percent of the whole cost of the sub-contract project. The arithmetic of labor cost can accord to the following formula: labor cost=Σ
4.1. The Cost, The Sub-contract Quality, and the Construction Project

The cost of various materials to build sub-contract project on EPC petrochemical engineering, some fixtures, some related use parts, some semi-manufactured and so on. The material expense roughly take up 50 percent of the whole cost of the sub-contract project. So the material expense can significantly affect the engineering cost. (3) The expenses of using construction machinery. The expenses of using construction machinery is to pay for machinery operation during sub-contract project construction, machinery installation and dismantling, transport outside of construction site, and so on. The expenses of using construction machinery roughly take up 10 percent of the whole cost of the sub-contract project. The expenses of using construction machinery is an important factor to reduce the sub-contract project cost.

3.3. The Construction Scheme of Sub-Contract Project Based on EPC Petrochemical Engineering

The cost of sub-contract project is largely determined by the legitimacy of sub-contract project construction scheme. Adopting different construction schemes can lead to different sub-contract project cost in final engineering settlement. Furthermore, some subcontractors use those materials in the actual construction which are different from the construction schemes plan to use. Some subcontractors use inferior materials instead of high-quality materials, the implementation of construction scheme sub-contract project don't follow the rules, which can lead to the poor quality of the construction and starting all over again. All of those can cause the increasing price of sub-contract project[8].

3.4. The Quality, Processes, Safety of Sub-Contract Project Based on EPC Petrochemical Engineering

(1) The quality of sub-contract project. The quality of sub-contract project is the life of sub-contract enterprise. Good quality can earn goodwill. The quality of sub-contract project directly affect credit standing of subcontractors, while it shall have a beneficial regulating effect on the level of sub-contract project cost. (2) The processes of sub-contract project. If the sub-contract project can not be completed on schedule, it can result in problems in asserting claims for damages, which will directly affect on the sub-contract project cost. The construction plan is flawed, or poor management of subcontractors, or poorly coordinated of the general contractor of EPC petrochemical engineering can have a certain impact on the schedule. Schedule delays can lead to increase related expenses, so it can increase the sub-contract project cost. (3) The safety of sub-contract project. During the EPC petrochemical engineering construction, there are some problems involved in building safety in the sub-contract project. The safety of sub-contract project have some influence on the sub-contract project cost. If the security problems have arisen, they shall be resolved quickly[8]. Because the compensation for construction safety often exceed sub-contract project budget.

3.5. Other Factors

(1) Measurement of engineering quantity. The amount of engineering quantity is the direct influencing factor for sub-contract project cost. It is an important reason to affect the accuracy of sub-contract project cost estimate whether the bill of quantities calculation of the amount of engineering quantity is accurate. (2) Construction on-site management of sub-contract project. During the sub-contract project, construction on-site management of sub-contract project affect not only the progress of the project, quality of sub-contract project but also the cost of sub-contract project. Poor on-site management of sub-contract project maybe cause engineering changes, which affects the sub-contract project cost. (3) The settlement of completed sub-contract projects. The settlement of completed projects is finalized cost, it is a key step of dynamic cost control in the whole process. It is the direct influencing factor for the goal of sub-contract project cost.

4. Some Control Strategies of Sub-contract Project Cost on EPC Petrochemical Engineering

4.1. Strengthen the Management of Sub-Contract
(1) Selecting the appropriate subcontractors. There are some factors to consider in selecting subcontractors. The general contractor should consider qualification grade of subcontractors, consider also whether the subcontractors have building permits, business licenses of scope of construction about relevant projects. The general contractor should consider construction technology and economic resources complementary of subcontractors. Expertise and resources complementary are the prerequisite and basis for successful cooperation of the EPC petrochemical engineering general contractor and subcontractors. The general contractor should consider performance of the subcontractors in the past. The financial conditions of subcontractors during the past few years often become an important element for the EPC general contractor selecting subcontractors to be a long-time partner. (2) Making the carefully worded sub-contract. Making the carefully worded sub-contract is an important means of sub-contract project cost for the EPC petrochemical engineering general contractor. The main economic terms of a sub-contract should embody the spirit of the EPC general contract. (3) Strictly fulfilling the sub-contract. Whether the sub-contract project cost can be strictly controlled, it is very important to strictly fulfilling the sub-contract. In some EPC energy engineering, sub-contracts can not be strictly fulfilled, causing disputes and management loophole, the sub-contract project cost out of control.

4.2. Strictly Control the Direct Expense of Sub-Contract Project
(1) The control of labour. Labour control is one of key points of direct expense of sub-contract project on EPC petrochemical engineering. Based on subcontractors operational management and construction technology level, the Labour is controlled. (2) The control of Materials. It is important for the general contractor to strictly prevent subcontractors cutting corners on sub-contract project of EPC petrochemical engineering. If the actual requisitioned materials of subcontractors exceed projections, the general contractor should analyze the reasons, give a penalty for unreasonable requisition of construction materials[9]. (3) The control of expenses of using construction machinery. The use of mechanized equipment should be made reasonable planning during sub-contract project construction. The general contractor should avoid expenses of using construction machinery out of control for the poor planning and equipment idle.

4.3. Strengthen the Management of Schedule, Quality And Safety
Schedule control quality control and safety control are important for sub-contract project cost on EPC petrochemical engineering. The quality management systems of sub-contract project should be improved. Before sub-contract project construction, professional training of personnel should be strengthened for enhancing quality control and the safe consciousness of the employees. If the Schedule of sub-contract project delays, subcontractor should find out cause and take an effective way to solve the delay, for example, increasing staffing and machinery to make up the before delay and prevent unnecessary sub-contract project cost increases. The funds of safe management should be allocated properly, there's enough funds of safe management to solve the safety problems in the construction of sub-contract project. Above methods are in favour of cost control of sub-contract project on EPC petrochemical engineering[10].

4.4. Optimize the Construction Scheme of Sub-Contract Project on EPC Petrochemical Engineering
Optimize the construction scheme of sub-contract project on EPC petrochemical engineering. Construction sequence of sub-contract project should be reasonably accommodated. With no additional construction resources, the construction schedule maybe reasonable speed up. Personnel and equipment idles are reduce as much as possible in order to effectively control the cost of sub-contract project on EPC model.

5. Summary
The control of sub-contract project cost on EPC petrochemical engineering is a systematic engineering with completeness. Beginning with selection of subcontractors, ended in the completion of sub-contract
project settlement, the control of sub-contract project cost is in charge of the relevant management department and budget officer. In order to provide a better control of sub-contract project cost for the EPC petrochemical engineering general contractor, more in-depth related studies should be carried out in the future.

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