4th Construction Specialty Conference
4e Conférence spécialisée sur la construction

Montréal, Québec
May 29 to June 1, 2013 / *29 mai au 1 juin 2013*

Conversion Method for Applying Convertible Contracts in Oil and Gas Projects

Mohammad Moazzami, Janaka Ruwanpura, and George Jergeas
Department of Civil Engineering, University of Calgary, Calgary, Alberta, Canada

Abstract: Unpredictable and fast track environment of oil and gas projects needs a flexible contractual framework to balance high level of risk and uncertainties shared between contracting parties and minimize potential claims, disputes, and litigation costs during the execution of the project. Convertible contracts, as a hybrid contracting strategy has been used in some oil and gas projects to optimize the risk taking/rewarding principle between project owners and contractors. In this contractual model, different contract price arrangements such as cost reimbursable, unit rate, and lump sum are used at different levels of project definition and through the project life cycle to allocate cost and performance risks between contracting parties appropriately. However, deciding the optimum time of conversion and effective conversion process have been the most challenging issues in managing convertible contracts. This paper proposes a systematic conversion process for applying convertible contracts in execution of a typical oil and gas project. The proposed conversion method is developed based on effective practices in estimating project costs and conversion factors required to convert a cost reimbursable contract to a fixed price arrangement in an Engineering, Procurement, and Construction (EPC) project. A dynamic cost estimating approach linked to the measured quantities during the pre-conversion period is defined to maximize the accuracy of the project lump sum value. Moreover, significant elements required to determine the realistic conversion factors at the time of conversion are discussed and classified in technical, commercial, and management categories.

Keywords: Oil and Gas, EPC projects, Convertible Contracts, Open Book Estimate

1. INTRODUCTION

Engineering and construction risks are inevitable elements in execution of oil and gas projects. Design errors/omissions, design changes, materials and equipment availability, labour availability/productivity, weather conditions, underground conditions, and other site problems are common risks in different phases of a construction project. Most of oil and gas projects are executed in a fast-track manner to reduce the project duration by overlapping project phases and activities. However, fast-tracking decreases the accuracy of the project estimation and increases the risk of more changes, reworks, and cost overruns. This high level of risks and uncertainties should be managed properly during the project development and execution. The project risk allocating/rewarding practice is managed by using a contractual mechanism with specific clauses agreed upon by contracting parties. There are different project delivery methods which define the contract scope of work. Most of oil and gas projects are performed under Design-Build or EPC delivery method in which all Engineering, Procurement, and Construction activities are performed by one entity or EPC contractor. Cost reimbursable and fixed price are two contract price arrangement commonly used in EPC projects. However, these traditional contracts

transfer the project risks to the project owner or the contractor inequitably. Convertible contract is an alternative approach to balance the risk allocating/rewarding to the contracting parties more appropriately. This paper offers a systematic conversion approach for applying convertible contracts in a typical oil and gas project.

2. CONTRACTING STRATEGIES

Contracting strategy has three main dimensions including project delivery method, contract price arrangement, and contract clauses.

2.1 Project Delivery Methods

Project delivery method designates the contract scope, roles, and responsibility of contracting parties. The most common project delivery methods in construction projects are Design-Bid-Build, Design-Build or EPC, and Construction Management. In Design-Bid-Build delivery method, engineering and construction activities are performed by two different entities. This approach provides the opportunity to start construction activities with complete engineering package which result in less rework in construction phase. However, additional bidding process to select different organization for performing construction activities is a time consuming approach which delays project completion. Moreover, using different organizations to perform engineering and construction activities increases the risk of more claims and disputes in project environment.

However, in a Design-Build strategy, one single organization executes engineering and construction phases of the project. This approach provides the opportunity to reduce the overall project duration by overlapping the engineering and construction phases. In addition, using the same organization to perform engineering and construction activities decreases potential claims and disputes in the project life cycle. Nevertheless, Design-Build delivery method gives more power to the contractor and lessens the owner control in project management and supervision. The EPC contract is an alternate term for Design-Build delivery method which is mostly used in oil and gas projects. If the scope of EPC contract covers commissioning and start-up activities in addition to the engineering, procurement, and construction phases of the project, the contract usually is called EPC Turnkey.

Construction Management is the other form of project delivery in which the contractor performs management activities on behalf of the project owner. In a particular form of this delivery strategy, EPCM, contractor performs engineering and procurement activities and manages the construction phase of project performed by another organization.

2.2 Contract Price Arrangement

Price arrangement is the other essential element of contracting strategy. Usually the contract is placed in one of three major types of fixed price, cost reimbursable, and guaranteed maximum price structures.

Lump Sum and Unit Price are two common forms of fixed price contracts. Contractor will be paid a fixed lump sum amount for performing the whole works, while the rate of performing each unit of work is fixed in a unit price contract.

Several variations are commonly used in the cost-reimbursable contracts including cost-plus percentage of cost, cost-plus fixed fee, and cost-plus incentive fee. In a cost plus percentage of cost contract, contractor is paid for its actual cost plus a specified percentage of cost, while in a cost plus fixed fee arrangement; contractor is paid for its actual cost plus a pre-agreed fixed fee (MacEving, 2001). In cost plus incentive fee, specific time or quality targets are defined in the contract. If the contractor meets the specified targets, it is paid its actual costs plus a set fee. If the contractor exceeds those targets, is paid an extra fee and if the contractor does not meet the criteria, the fee is less (Fisk and Reynolds, 2006).

In guaranteed maximum price contracts, contractor is paid his actual cost in addition to an agreed upon fee while he guarantees that the total cost to the owner will not exceed a stipulated maximum amount (Boukendour, 2001).

2.3 Contract Clauses

Contract clauses in the project contract document specify the interests and commitments of contracting parties and assign the project risk to them. Standard form of contracts have been published to be used in different project delivery methods by international and national professional associations such as FIDIC (International Federation of Consulting Engineers), American Institute of Architects (AIA), the Associated General Contractors of America (AGC), and Construction Owners Association of Alberta (COAA). However, contract clauses and provisions can be written by contracting parties subject to the project specific conditions.

3. OIL AND GAS PROJECTS

Engineering, Procurement, and Construction (EPC) is a common delivery method in execution of oil and gas projects. This approach provides the opportunity to overlap engineering and construction phases and reduce the overall project duration. However, starting construction activities without complete engineering package increases the risk of more changes and reworks and might result in project cost overrun. Therefore, an appropriate contractual arrangement is required to manage this high level of risk and uncertainties. Cost reimbursable and lump sum are frequently used schemes to arrange the contract price in EPC projects.

Cost reimbursable contracts are more flexible to changes and unpredictable situations in fast-track projects, while lump sum requires a complete scope of work that fully defines project requirements. The main advantage of lump sum contracts is to know the ultimate cost required to complete the project. In a reimbursable contract, though, owner does not have a clear vision of his financial commitment and contractor is not motivated to cut the project costs (Nkuah, 2006). Selecting contractor in a cost reimbursable contract is usually a subjective, easy, and fast process, while it is a formal, difficult, and slow process in the lump sum contracts. However, due to the complete project definition, the execution phase of the project is usually more efficient and shorter in lump sum framework. Under a cost reimbursable contract, project risks are mostly transferred to the owner, while they are generally taken by the contractor in a lump sum arrangement.

Above discussions show that cost reimbursable and lump sum contracts shift the project risks to the owner or contractor inequitably.

4. CONVERTIBLE CONTRACTS

Convertible contract is an alternate solution to balance the risk allocation to the contracting parties in EPC projects. This strategy has been mostly used in oil and gas projects performed in the Middle East. According to Brkic and Romani (2009), the convertible contract starts under a cost reimbursable scheme when the scope of work is incomplete and once the project is well defined, converts to a fixed lump sum price. This contractual framework brings several benefits to the project. Starting the project under a cost reimbursable contract reduces the risk premiums and contingency amounts due to the incomplete project definition and scope of work. Besides, converting the contract when the contractor has more accurate information to bid a realistic fixed price provides a clear vision of the project overall cost.

Convertible contracts accommodate fast-tracking and balance project risks in EPC projects. However, the optimum time of conversion and effective conversion process are important challenges for project owners and contractors to apply convertible contracts in projects.

4.1. Time of Conversion

One of major challenges in applying convertible contracts is determining the optimum time of conversion. Usually, a reasonable amount of progress in detailed engineering (50%-60%) or subcontracted work packages before conversion are accepted measures to decide appropriate time of conversion. However, these factors do not cover all important aspects of a project such as market condition, project complexity, and level of risk and uncertainties which influence on deciding the optimum time of conversion.

Using Project Definition Rating Index (PDRI) will be a more reliable approach to indicate the proper time of conversion. PDRI, developed by the Construction Industry Institute (CII), is a reliable tool to measure the project definition level. This effective tool consists of 3 main sections, 15 categories, and 70 elements in a weighted checklist format (Dumont et al., 1997). The main sections are: Basis of Project Decision, Front End Definition, and Execution Approach. By covering the most significant elements in project definition, PDRI is a more meaningful variable to decide the appropriate time of conversion rather than simply the percentage of detailed engineering completion. The PDRI score ranges from zero to 1,000. A lower score means higher level of project definition.

Considering the above discussions, the time of conversion can be decided based on the probability of achieving acceptable cost certainty and pre-conversion durations at particular levels of the project definition (PDRI scores). This strategy enables the project decision makers to determine the level of project definition at which the contract should be converted to achieve the acceptable cost variance (CV %) and conversion ratio (CR %) in the project. Cost variance is the difference between the actual total cost of the project and the estimated lump sum price at the time of conversion. The conversion ratio is the pre-conversion duration over the total project duration.

Measuring the probability of achieving acceptable CV% and CR% at each certain amount of project definition needs a quantitative analysis. The required data can be gathered from statically large enough number of projects with available cost and schedule information at particular PDRI scores. This quantitative analysis is planned to be done in the future studies by the authors after collecting all required data. However, the sufficient engineering progress (50%-60%) to convert the contract is usually achieved when PDRI score is between 100 and 300.

4.2. Conversion Method

A dynamic and flexible estimation approach is required to address the complexity of conversion process in a convertible contractual framework. Open Book Estimate (OBE) is an effective method to estimate a more accurate and reliable EPC lump sum price at the time of conversion (Patty and Denton, 2010). In an open book estimate, both EPC contractor and owner participate in developing the estimate and have full access to all cost information.

The right approach to build a concrete Work Breakdown Structure (WBS) is essential to measure the work quantities accurately and to develop an effective OBE during the pre-conversion phase of the project. The proposed method for converting the contract consists of following steps:

Step 1) Developing Cost Breakdown Structure (CBS)

The main cost categories can be identified based on the project WBS. There are different approaches to develop project WBS. However, the best cost breakdown structure to accommodate the open book estimate methodology is based on project disciplines. This classification provides a standard model to identify cost packages regardless of the project or process type. The proposed classification covers all key disciplines including Management, Engineering, Procurement, and Construction as well as their sub-divisions. Cost categories should be identified in each discipline based on the experience and available data in previous similar projects. Each cost category can be divided into several sub-categories and cost items. Table 1 shows the proposed cost breakdown structure in 3 levels of Cost Category (Discipline), Cost Sub-Category (Sub-Division), and Cost Item.

Table 1: Cost Breakdown Structure

Cost Category	Cost Sub-Category	Cost Item
1: Management	1.1: Project Management	1.1.1: Home Office 1.1.2: Site
	1.2: Project Planning, Control, and Administration	1.2.1: Home Office 1.2.2: Site
	1.3: Project Quality Management	1.3.1: Home Office 1.3.2: Site
	1.4: Project HSE Management	1.4.1: Home Office 1.4.2: Site
	1.5: Construction Management	1.5.1: Home Office 1.5.2: Site
2: Engineering	2.1: Design Basis Memorandum (DBM) 2.2: Front End Engineering and Design (FEED) 2.3: Detailed Design Package	
3: Procurement	3.1: Procurement Services	3.1.1: Home Office 3.1.2: Site
	3.2: Supply of Bulk Materials	3.2.1: Piping 3.2.2: Structural Steel 3.2.3: Electrical 3.2.4: Instrumentation 3.2.5: Chemicals 3.2.6: Transportation
	3.3: Supply of Equipment	3.3.1: Pumps 3.3.2: Compressors 3.3.3: Mixers 3.3.4: Ejectors 3.3.5: Heaters/Boilers 3.3.6: Heat Exchangers 3.3.7: Tanks 3.3.8: Vessels/Towers 3.3.9: Spares Parts 3.3.10: Transportation 3.3.11 : Others
4: Construction	4.1: Yard Fabrication	4.1.1: Modules 4.1.2: Structural 4.1.3: Piping 4.1.4: Electrical 4.1.5: Instrumentation
	4.2: Temporary Construction Facilities	4.2.1: Site Facilities 4.2.2: Site Utilities
	4.3: Site Accommodations/Camp	
	4.4: Site Construction and Installation	4.4.1: Civil Works 4.4.2: Equipment 4.4.3: Tanks 4.4.4: Piping/Insulation 4.4.5: Electrical 4.4.6: Instrumentation 4.4.7: Painting 4.4.8: Others
	4.5: Pre-Commissioning 4.6: Commissioning & Start-Up	

Step 2) Estimation of Quantities

Measurement of project quantities is a key factor in estimating the project costs. The accuracy of measuring project quantities or Material Take Off (MTO) strongly depends on the level of engineering and design development at the time of estimation. The essential engineering documents required for MTO in the main disciplines are listed in Table 2.

Table 2: Key Documents Required for MTO

Discipline	Key Documents Required for MTO
Piping	▪ Plot Plans ▪ Piping and Instrumentation Diagrams (P &IDs) ▪ Piping Specification ▪ 3D Model
Civil and Steel Structure	▪ Plot Plans ▪ 3D Model ▪ Topographical Survey ▪ Geotechnical Reports ▪ Civil Specifications ▪ Geometrical Characteristics of the Structures
Instrumentation	▪ Plot Plans ▪ Piping and Instrumentation Diagrams (P &IDs) ▪ Building Layouts ▪ Number of I/Os ▪ Cable Schedule ▪ Preliminary Cable Route Studies ▪ Instrumentation Specifications
Electrical	▪ Plot Plans ▪ Piping and Instrumentation Diagrams (P &IDs) ▪ Single Line Diagram ▪ Electrical Load List ▪ Preliminary Cable Route Studies ▪ Preliminary Cable Sizing ▪ Cable Schedule ▪ Earthling System Studies ▪ Electrical Specifications

Step 3) Compensation Methods

A) Pre-Conversion Period: Reimbursable Scheme

Compensation method during the pre-conversion period is on a cost reimbursable basis. In general, compensation will be based on the actual cost of each item plus pre-agreed overheads and benefits. This method has been formulated for different management, engineering, procurement, and construction cost items in below:

- **Management, Training Services to Client, Engineering, and Procurement Services**

  Compensation of Management, Training, Engineering, and Procurement services during the pre-conversion period is on a reimbursable basis and based on pre-agreed unit rates of home office and site services for each category.

  Compensation Method:

  a. Home Office: (Actual Home Office Man-hours) * (Pre-Agreed Home Office Unit Rate) + Overheads (Pre-Agreed Percentage for the Home Office) + Benefits (Pre-Agreed Percentage for the Home Office)

  b. Site: (Actual Site Man-hours) * (Pre-Agreed Site Unit Rate) + Overheads (Pre-Agreed Percentage for the Site) + Benefits (Pre-Agreed Percentage for the Site)

- **Supply of Bulk Material**

  EPC contractor will be reimbursed for supplying the bulk material during the pre-conversion period based on actual cost of purchased materials plus pre-agreed overhead costs and benefits. Contractor estimates material quantities based on available engineering information and the last MTO. In accordance to the OBE strategy, owner has full access to the unit price lists generated from vendor quotes and compensation will be under a reimbursable basis.

  Compensation Method:

  (Actual amount of Purchase Orders for purchased materials up to the time of conversion) + Overheads (Pre-Agreed Percentage for the Bulk Materials) + Benefits (Pre-Agreed Percentage for the Bulk Materials)

- **Supply of Equipment**

  Compensation of supplied equipment during the pre-conversion period is based on actual cost of purchased equipment plus pre-agreed overhead costs and benefits. Based on the OBE method, owner has full access to the vendor bids for the equipment.

  Compensation Method:

  (Actual amount of Purchase Order for purchased equipment up to the time of conversion) + Overheads (Pre-Agreed Percentage for the Equipment) + Benefits (Pre-Agreed Percentage for the Equipment)

- **Construction**

  EPC contractor will be reimbursed for the yard and site activities during the pre-conversion period based on actual cost of sub-contract packages plus pre-agreed overhead costs and benefits. In accordance to the OBE strategy, owner has full access to the unit rates quoted by sub-contractors for performing construction work packages.

Compensation Method:

(Actual amount of sub-contract packages) + Overheads (Pre-Agreed Percentage for the Construction) + Benefits (Pre-Agreed Percentage for the Construction)

B) Post-Conversion Period: Lump Sum Scheme

Conversion Factors

In order to minimize the risk of project cost overrun and to provide a more realistic EPC lump sum price at the time of conversion, the potential risks should be identified and addressed appropriately in estimation and compensation process. However, an effective OBE strategy will not result in excessive risk premiums and contingencies.

a) **Technical Design Allowances (TDA):** Incomplete engineering at the time of conversion, design changes after conversion, technical complexity, and design are potential design risks which will affect the accuracy of the estimate. These risks should be addressed by considering pre-agreed percentages as the Technical Design Allowances (TDA) in estimating lump sum price of material, equipment, and construction activities at the time of conversion.

b) **Risk Factor (RF)**: Rapid changes in oil and gas market conditions, political issues, material cost variations, labour market changes, inflation, and escalation are major commercial and management risks. These risks should be addressed by a pre-agreed percentage as the Risk Factor (RF) in estimating lump sum price of material, equipment, and construction activities at the time of conversion.

Compensation method for the main cost categories after conversion is on a lump sum basis. This method has been formulated for different management, engineering, procurement, and construction cost items in below:

- **Management, Training Services to Client, Engineering, and Procurement Services**

  Compensation of Management, Training, Engineering, and Procurement services after the conversion is on a lump sum basis. Earned Value Analysis (EVA) is the proper tool to forecast the required man-hours to complete above activities in the project. Compensation will be based on the Estimate to Complete (ETC) man-hours resulting from EVA and pre-agreed fixed rates of home office and site activities for each category.

  Compensation Method:

a. Home Office: (ETC Home Office Man-hours) * (Pre-Agreed Home Office Unit Rate) + Overheads (Pre-Agreed Percentage for the Home Office) + Benefits (Pre-Agreed Percentage for the Home Office)

b. Site: (ETC Site Man-hours) * (Pre-Agreed Site Unit Rate) + Overheads (Pre-Agreed Percentage for the Site) + Benefits (Pre-Agreed Percentage for the Site)

- **Supply of Bulk Material**

  Compensation of bulk materials “to be supplied” after conversion will be on a lump sum basis and based on the last MTO of the bulk item at the time of conversion and available unit price lists generated from vendor quotes in accordance to OBE Strategy.

  Compensation Method:

  (Bulk MTO at the time of conversion) * (Unit Price decided in OBE) * TDA* RF

- **Supply of Equipment**

  Compensation of equipment “to be purchased” after the conversion will be on a lump sum basis and based on the estimated quantities of the equipment at the time of conversion and available vendor bids in accordance to OBE Strategy.

  Compensation Method:
  (Equipment quantity estimate at the time of conversion) * (Vendor Bid decided in OBE) * TDA* RF

- **Construction**

  Compensation of construction activities after conversion will be on a lump sum basis and based on the estimated construction man-hours for “to be fabricated/constructed/installed/” items.

  Compensation Method:

  (Estimated Construction Man-Hours based on the last MTO at the time of Conversion)* (Construction Unit Rates decided in OBE)* TDA *RF

Conducting an effective Open Book Estimate through steps mentioned above will increase the accuracy of EPC lump sum price and will result in a smooth conversion from a cost reimbursable contract to the lump sum scheme. This methodology addresses one of the main concerns of contracting parties in applying convertible contracts.

5. Conclusion

Engineering, Procurement, and Construction (EPC) is a common delivery method in execution of oil and gas projects. This approach provides the opportunity to overlap engineering and construction phases and reduce the overall project duration. However, starting construction activities without complete engineering package increases the risk of more changes and reworks and might result in project cost overrun. Therefore, an appropriate contractual arrangement is required to manage this high level of risk and uncertainties. Cost reimbursable and lump sum are frequently used schemes to arrange the contract price in EPC projects.

Convertible contracts, as a hybrid contracting strategy has been used in some oil and gas projects to optimize the risk taking/rewarding principle between project owners and contractors. A convertible contract starts under a cost reimbursable scheme when the scope of work is incomplete and once the project is well defined, converts to a fixed lump sum price. However, the optimum time of conversion and

effective conversion process are important challenges for project owners and contractors to apply convertible contracts in projects.

Usually, a reasonable amount of progress in detailed engineering (50%-60%) or the amount of subcontracted work packages before conversion are accepted measures to decide appropriate time of conversion. However, these factors do not cover all important aspects of a project such as market condition, project complexity, and level of risk and uncertainties which influence on deciding the optimum time of conversion. Project Definition Rating Index (PDRI), developed by the Construction Industry Institute (CII), is a more reliable tool to determine the proper time of conversion. The time of conversion can be decided based on the probability of achieving acceptable cost certainty and pre-conversion duration at particular levels of the project definition (PDRI scores).

In particular, this paper presents a systematic conversion process for applying convertible contracts in execution of a typical oil and gas project. A dynamic and flexible estimation approach is required to address the complexity of conversion process in a convertible contractual framework. Open Book Estimate (OBE) is an effective method to estimate a more accurate and reliable EPC lump sum price at the time of conversion. The proposed method for converting the contract consists of following steps:

Step 1) Developing Cost Breakdown Structure (CBS)
Step 2) Estimation of Quantities
Step 3) Compensation Methods

The Open Book Estimation strategy will result in a smooth transition from a reimbursable price arrangement to the lump sum contract. This method addresses one of the main challenges of applying convertible contracts.

6. REFERENCES

Boukendour, S. and Bah, R. (2001). The Guaranteed Maximum Price Contract as Call Option. *Construction Management and Economics*, 19(6), 563–567.

Brkic, D. and Romani, D. 2009. Unconventional Contractual Schemes for Fast-Track Projects in the Oil & Gas Industry. *Petrotech 2009,* Delhi, India, 290-294.

Carty, G.J., 1995. Construction. *Journal of Construction Engineering and Management*, 121(3): 319–328.

Dumont, P.R., Gibson, G.E., and Fish, J.R. (1997). Scope Management Using Project Definition Rating Index, *Journal of Management in Engineering*, 13(5), 54-60.

Fisk, E.R., and Reynolds, W.D. (2006). Construction Project Administration. New Jersey: Pearson Prentice Hall.

MacEwing, J. M. (2001). Cost Plus Not A Blank Cheque. *Journal of Commerce*, 90(25), ISSN: 0709-1230, Start Page: 3.

Nkuah, M.Y. 2006. Progress and Performance Control of a Cost Reimbursable Construction Contract. *Cost Engineering*, 48(5): 13–18.

Patty, R.M, and Denton, M.A. (2010). The End of Project Overruns: Lean and Beyond for Engineering, Procurement and Construction. Boca Raton, Florida: Universal Publishers.