Quality Management System (QMS) for Engineering, Procurement, Construction/Fabrication and Installation (EPCI) Operations on Oil and Gas Projects

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ABSTRACT

Quality Management System (QMS) is one of the key elements to the success of any oil and gas project. Along with standardization of processes, QMS equips project team with documented approach that helps in maintaining the quality of work, reduction of rework and cost effective project execution. This research paper focuses on details of exhaustive activities that QMS on oil and gas projects should cover and address for engineering, procurement, construction/fabrication and installation (EPCI) operations.

Keywords — Engineering, Procurement, Construction and Installation (EPCI), Oil and Gas projects, Oil and Gas Industry Challenges, Project Quality Management System (PQMS), and Quality Management System (QMS).

I. INTRODUCTION

Oil and Gas economy has been at its low for few years now. Crude oil prices have been ranging from USD 40 to USD 50 per bbl since 2015 to now with lowest of around $30+ per bbl in the late 2015, early 2016 [1], refer to Fig.1. Historical oil price declining trends have cascading adverse effects on the entire supply chain i.e. on oil and gas operators, Engineering, Procurement, Construction and Installation (EPCI) contractors, suppliers, and fabricators. Entire supply chain is impacted adversely and thus looking for ways of planning and executing oil and gas projects in “a new normal way” and in a more cost-effective manner. At the core of this planning and execution is Quality Management System (QMS). American Society for Quality (ASQ) defines QMS as a formalized system that documents processes, procedures, and responsibilities for achieving quality policies and objectives [2]. Typically, Quality Management Systems serve many purposes including improving processes, reducing waste, lowering costs and setting organization-wide direction [2]. This research paper discusses details of exhaustive activities that QMS on oil and gas projects should cover for engineering, procurement, construction/fabrication and installation operations. Successful planning and effective implementation of QMS for each phase operations increases the probability of successful and cost effective execution of oil and gas projects [3].

II. QUALITY MANAGEMENT SYSTEM FOR ENGINEERING

Engineering phase is backbone of an EPCI (Engineering, Procurement, Construction and Installation) project and thus critical to the success of the project. There are numerous interdisciplinary activities involved and enormous number of deliverables are required to be produced in this phase. Therefore, sound technical checks and balances need to be performed by project engineering team. Quality Management System (QMS) plays a vital role in planning, analyzing and executing these checks and balances.
QMS for Engineering planning and execution activities should include:

- Processes for manpower planning – quality and quantity of engineering resources.
- Defined clear roles and responsibilities for engineering team including engineers, engineering leads and engineering manager.
- Strategy for engineering execution.
- List of engineering deliverables (procedures, plans, reports and discipline design instructions etc.) applicable for the project and monitoring their progress.
- Schedule of engineering activities and deliverables.
- Mechanism to gather, review and analyze engineering requirements for involved disciplines such as Electrical and Instruments, Piping, Mechanical, Heating, Ventilation and Air Conditioning (HVAC), Fire and Safety, Process and Civil and Structural etc.
- Plan to deal with change orders for engineering scope of work.
- Defining equipment list.
- Schedule for various reviews such as design reviews, constructability reviews, technical safety and risk reviews, and engineering gate reviews etc.
- Establishing Document distribution matrices.
- Discipline wise list of originators, reviewers and approvers for engineering deliverables.
- Process for interface across engineering disciplines.
- Audit schedule for engineering activities.
- Process for Technical queries, deviations and concessions.
- Interface Management process to handle interfaces among stakeholders e.g. EPCI contractor, Joint Venture partners and Client (typically oil and gas operator).
- Process for Non-conformances for engineering activities.
- Lessons learned plan and process for engineering operations.
- Engineering reporting – requirements, format and frequency.
- Clearly defined engineering objectives and key performance indicators (KPIs).
- Risk identification and mitigation plans for engineering risks.
- Establishment of training plan for project engineering team members.

Success of engineering execution is typically directly proportional to engineering planning activities and diligent efforts during engineering phase. Qualified engineering resources with defined roles and responsibilities, clearly documented processes, plans and schedule of activities and continuous monitoring of compliance with QMS multiply the probability of successful execution of engineering operations.

### III. QUALITY MANAGEMENT SYSTEM FOR PROCUREMENT

Ernst & Young (EY), a global leader in consulting services, in its “Spotlight on oil and gas megaprojects” [4] state poor procurement of contractors as one of the contributing factors for cost overruns and delays on oil and gas projects. In the similar vein, World Economic Forum’s 2014 report prepared in collaboration with A.T. Kearney [5], a leading management and consultancy firm, also identified execution challenges in procurement as one of the root causes of capital project deviation from planned performance. QMS for procurement, if developed diligently, can certainly minimize procurement planning and execution risks.

QMS for Procurement planning and execution activities should include:

- Manpower planning – quality and quantity of procurement resources.
- Defined clear roles and responsibilities for procurement personnel such as buyers, expeditors, logistics coordinators, technical and administrative inspection coordinators, inspectors and procurement manager.
- List of procurement deliverables – procedures, plans, reports and monitoring their progress.
- Review and approval process for procurement deliverables along with identification of qualified reviewers and approvers.
- Identification of long lead items.
- Plan to identify procurement related risks and establish mitigation plans.
- Equipment and materials list along with criticality assessment process and determination of criticality ratings.
- List of potential bidding suppliers by equipment and materials.
- Strategy for high value procurement suppliers.
- Bid invitation and evaluation process.
- Strategies for bidding such as competitive, non-competitive, sole source, and single source etc.
- Purchase order (PO) – negotiation, award, administration and close-out process.
- Logistics strategy.
- Process for warranty and claims management.
- Supplier qualification - requirements and process.
- Supplier performance monitoring and feedback process.
• Warranty management process.
• Procurement schedule.
• Procurement reporting – requirements, format and frequency.
• Change order process related to procurement activities.
• Expediting process.
• Inspection plan and procedures.
• Inspector assignment process along with inspection report requirements, format and frequency.
• Insurance planning and procedures.
• Establishment of Procurement objectives and KPIs.
• Process to manage supplier non-conformances.
• Training plan for procurement personnel.
• Lessons learned plan and process for procurement activities.
• Risk identification and mitigation plans for procurement risks.

IV. QUALITY MANAGEMENT SYSTEM FOR CONSTRUCTION/FABRICATION

Typically, in terms of investment proportion in oil and gas projects, Construction accounts for 30-50% [6], which is a significant portion of overall project cost. If construction activities are not planned and managed effectively, returns on sound engineering and procurement work can easily start diminishing. To maximize effectiveness of construction management, it is critical to have QMS in place for construction activities. QMS should also be integrated with constructability principles during construction planning [7].

QMS for Construction planning and execution activities should include:
• Manpower planning – quality and quantity of construction resources for home office and construction site(s).
• Construction strategy and Construction execution plan.
• List of Construction deliverables – plans, procedures and reports, and monitoring their progress.
• Review and approval process for construction deliverables along with identification of qualified reviewers and approvers.
• Construction schedule.
• Identification and selection of subcontractors.
• Schedule for Constructability reviews.
• Interface management with engineering, procurement and other functions.

• Data requirements from Engineering and Procurement.
• Strategy for modularization.
• Mobilization and demobilization plans.
• Site survey data.
• Site procurement and materials management plan.
• Lifting plans.
• Mechanical completion and handover strategy and plans.
• Plan for Subcontracting.
• Training plan for construction resources.
• Construction objectives and KPIs.
• Change Management Process for construction activities.
• Management of Change process for construction activities.
• Non-conformance management process for construction activities.
• List of required inspection and test plans.
• Preservation and maintenance requirements, process and monitoring mechanism.
• Construction document, data and records management process.
• Materials traceability process.
• Construction site material receiving and inspection process.
• Dimensional Control process.
• Identification of requirements and documented processes for special processes such as welding, non-destructive testing (NDT), and coating etc.
• Construction Dossier requirements and Data Book table of contents.
• Construction reporting – requirements, frequency and format.
• Construction lessons learned plan and process.
• Construction hazard identification review plan.

V. QUALITY MANAGEMENT SYSTEM FOR INSTALLATION

Offshore installation operations typically involve myriad stakeholders and complex web of activities starting from mobilization to installation offshore to demobilization. Detailed planning, documentation, reviews and verification activities are involved in offshore installation operations. A documented system such as QMS minimizes rework and improves quality of work to be performed offshore.

QMS for Offshore Installation planning and execution activities should include:
• Manpower planning – quality and quantity of offshore installation resources.
• Vessels – identification of vessels and their availability.
• Schedule for readiness reviews and hazard identification reviews.
• Vessel assurance program.
• Installation analysis by scopes.
• SIMOPS (Simultaneous Operations) – identification and plan.
• Mobilization and demobilization plans for offshore resources.
• List of offshore installation deliverables – plans, procedures, and reports monitoring their progress.
• Review and approval process for offshore installation deliverables along with identification of qualified reviewers and approvers.
• List of inspection and test plans to be used offshore.
• Management of change process for offshore installation activities.
• Non-conformance management process for offshore installation activities.
• Offshore Installation reporting – requirements, frequency and format.
• Training plan for offshore resources.
• Permits management.
• Offshore Installation objectives and KPIs.
• Lessons learned process for offshore installation activities and operations.

VI. SCOPE OF FUTURE RESEARCH

In his future research, author may perform extensive analysis of QMS activities by operations e.g. engineering, procurement, construction and installation. This analysis may include both qualitative and quantitative aspects of QMS activities that benefit in effective execution of EPCI operations on oil and gas projects.

VII. CONCLUSION

Spectrum of activities and associated operations on EPCI projects are significant portion of oil and gas industry. Success or failure of EPCI projects impacts oil and gas operators, EPCI contractors, suppliers and fabricators positively or negatively in a significant way. Sound planning and effective execution of EPCI projects in a cost-effective manner is one of many factors that will help oil and gas industry recovering from the current downturn. QMS plays an important part in planning and execution for engineering, procurement, construction and installation operations of oil and gas projects. QMS provides better process integration, improves the evidence for decision making, standardizes processes and creates a culture of continual improvement [8]. Details of exhaustive activities mentioned in this research paper that QMS on oil and gas projects should cover and address for engineering, procurement, construction/fabrication and installation (EPCI) operations will assist companies in oil and gas sector in refining and streamlining their QMS to ensure cost effective and quality execution of EPCI projects.

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REFERENCES