TECHNOLOGY AND ORGANIZATION OF CONSTRUCTION

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QUALITY ASSURANCE IN THE CONSTRUCTION OF OIL AND GAS FACILITIES

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Statement of the problem. The quality of construction is a complex issue, which is a guarantee of durability and reliability of buildings and constructions, their safety and efficiency during operation. Existing legislative and technical standards do not provide adequate compliance with the quality requirements. The SRO system adopted in the construction has sufficient tools to address the problems and failed to deliver on expectations. The assessment of the quality of construction products is closely connected with the notion of its defects that is uncommon these days.

Results. The causes of problems in relations between the contracting oil and gas companies with contractors are considered and established. The proposed mechanism is increasing the responsibility of the contractor through documentation of their self-control and introduce in the practice the construction procedure for presenting the work performed to the client.

Conclusions. The proposed activities will enhance the level of responsibility of the contractor construction control of work performed, to ensure the accuracy and objectivity of its results, keep a record of defects of construction products, and as a result, the quality of construction of oil and gas industry.

Keywords: oil and gas objects, contracting organizations, quality of construction products, construction defects, quality assessment.

Introduction

The existing construction guidelines that are legislative acts and technical regulations fails to provide a relevant construction quality. Most guidelines focus on defining safety of buildings and structures,

which is not the same. Improving the quality and reliability of construction works is not largely regulated by state institutions and is overlooked by self-regulating bodies that do not exert sufficient influence and thus fail to do their job well. The resulting current inconsistency lead to the situation when it is mainly the contractor's task to evaluate the quality of any work performed.

The importance of the paper is to increase the contractor's responsibilities by enforcing the internal construction control.

All the objects of oil processing are classed as particularly hazardous. Decline risks at corresponding sites are reduced at the technical task stage.

Designing takes places in the process of construction and operation and ultimately depends on the arrangement of the general contractor and contractor's control system at all the stages of a building's life cycle. It is only if the quality control is stringently regulated and papers regarding construction works and services are supervised that the process runs smoothly [7].

The existing guidelines regulate certain control procedures but they are inconsistent and voluntary to apply.

A significant role in improving construction production quality is played by the International Standartization Organization (ISO) that is a global federation of national organizations for standardization (ISO member committees). Each committee, which is a member that is interested in activities involving a technical complex, is eligible to be represented on this committee. International representatives and non-profit organizations that have to do with ISO are also in charge [12].

The international guidelines include the requirements that rule what elements are essential in the control system. However, the purpose of these standards is not to impose anything that all quality systems are expected to share. These standards are universal and independent of any particular industry. The development and implementation of the control management system are impacted by particular needs of an organization, certain tasks it tackles, products and services it provides as well as the manufacturing technologies and experience employed in the end product.

1. Organizational aspects of construction control

It is common practice to distinguish several levels of the quality control of the building infrastructure. Let us consider each individually.

First, this is a normative level. Here construction control is performed based on the compliance of the parameters of an object with the State Standard (GOST), etc. requirements that are applied in a relevant economic activity the contractor's work and its outcome are related to [2].

Secondly, this is a factual level. It allows one to evaluate the construction quality according to available measurements as a building is constructed in compliance with a corresponding agreement. The factual level commonly depends on how the designer managed to stick to the criteria as specified in the regulations.

Thirdly, there is a so-called operational level of the quality of construction objects. It involves the evaluation of customers' needs and demands. It takes into account the quality of an object and its compliance with the guidelines but it might also be subjective. An agreement between the contractor and designer typically stipulates the compliance to the guidelines only. Therefore a potentially low estimate of the former's work based on the operational characteristics of buildings or structures generally bears no legal consequences. But in the long term it might affect future agreements between both parties.

The control of the quality of products and services is an essential part of risk management. It largely relies on the results, timeliness, quality and expertise of everyone involved in the construction process and provision of necessary resources [7].

Construction quality is a set of activities that are conducted in order to ensure the quality of works and construction materials, costs, labour and deadlines [13]. Construction control is a multi-faceted integrated system that includes activities and procedures that are crucial to any stage of construction, reconstruction, major repairs of major construction [17, 18].

Construction control consists of the contractor's (customer's) control, laboratory control, the designer's guidance, engineering control. Construction control can be conducted by means of monitoring the technical state of buildings and structures, particular structures and construction systems, environment and its condition if the contractor (customer) is willing [18].

The purpose of construction control is [12]:

— providing the necessary construction quality;

— controlling the quality of the construction materials used for a particular project;

— controlling the financial costs and auditing of expenses;

— controlling the construction times;

— controlling the health and safety standards.

The control quality system in construction consists of the following elements [15]:

— construction control:

- original control of the relevant documentation,
- original control of structures, materials and production,
- operational, geodesic, individual, laboratory, inspectional and end control,

- technical contractor's (designer's) control as specified in the legislation and guidelines;

— guidelines regarding a quality control system in a construction organization:

- State Standard (GOST) Construction Standards and Regulations,
- technological maps,
- instructions,
- operational control schemes, etc.;

— organizational structure of the quality control of a construction organization regarding individual responsibilies and authorities;

— control of the expertise of engineering and technological staff;

— introduction of executive guidelines regarding the visualization of the construction quality results (journals, acts and other documents as specified in the legislation and regulations);

— measurements in construction.

Providing the quality of construction objects has been an important issue throughout many centuries since construction emerged. What is particular to construction is that its outcomes achieved at different stages of construction and a building's life cycles are mutually dependent: findings in engineering, designing, construction, operation and utilization. As a result, mandatory interdependent construction standards and regulations emerged in the developed countries. In 2005 the UK's Ministry of State for Trade developed and published the Unified Standard Minimum that has the status of the essential guidelines and is thus complied with as part of any construction project performed by any organization that is involved in trade for construction contracts. This kind of document is present in many western countries. However, in Russia the technical guidelines are designed differently and construction guidelines are voluntary as well as (limitedly) mandatory documents [20, 21].

Construction control on oil and gas objects is provided in accordance with local guidelines (e.g., Constructions Standards and Regulations by the Gazprom Company 2-2.2-860-2015 "On the Organization of the Contractor's Construction Control in Construction, Reconstruction and Major Repairs of Objects Owned by Ltd. Gazprom or OR-91.200.00-KTN-045-14 "On the Provision of the Contractor's Construction Control for Construction and Assembly of Objects Owned by the Transneft System) at all the corporative management levels [3, 4]. These documents oversee strict distribution of duties and responsibilities between respective structures of the contractor and sub-contractor [14].

There are different approaches to subordination within a construction control service in oil processing, transportation and carbohydrate processing.

1.1. First approach

For oil and gas processing enterprises it is typical to organize a service in charge of dealing with contractors and signing construction agreements [16]. They are run by Head Engineer or Head of an enterprise. This is the case in large cooperations and alliances.

We argue that this approach is the most viable one as the level and status of a corresponding service enables other departments involved in construction projects (major construction department, financial department, etc.) to cooperate. In addition, commitment to a technical task prior to trading allows a potential customer to address a number of their concerns regarding arrangement, region or object of construction. Involvement in the contractor's agreement allows extra forms and report policies to be incorporated as well as the subcontractor to be made liable for extra responsibilities.

1.2. Second approach

For some processing enterprises (oil and gas industry) construction control services are typically within an existing department structure. Hence in some factories the corresponding staff were part of the main mechanics or technology department. It is beyond doubt that it is the primary goal to ensure than relevant technological processes are ongoing in factories and plants. Besides, the above individuals in change of construction control have maximum management resources to draw on and run most funding. However, these specialists do not normally have any construction qualifications and expertise to act on the relevant issues.

In this case construction control in oil and gas enterprises normally loses much of its authority in subcontracting organizations and cannot thus take part in trading and preparing relevant documentation.

One of the most unfortunate aspects of such a subordination approach is that the service specialists are not able to exert any authority on the major levels. Their decisions and recommendations automatically get a lower status than is necessary for the proper quality of construction, reconstruction and major repairs.

1.3. Third approach

Another form of organizing a construction control service is getting an engineering company on board [19]. It is obvious that for an enterprise that is not directly involved in investment and construction and thus has no specialists with relevant qualifications on the staff, this option appears most viable.

Along with a few obvious advantages this approach offers such as no need to establish a proper service and hiring extra staff members, etc., there are other things to consider:

— arranging on-site control (inspection) of an engineering company;

— providing an engineering company with necessary communication media;

— a customer's dedication to a technical task and contract in each object of construction, reconstruction and major repairs.

2. Dealing with defects in oil and gas construction

A construction defect is some work performed in violation of the technical guidelines or damage of certain parts of a designed object through the course of subsequent work. A construction and assembly defect can be caused by faults in the final version of a project and working drawings (errors, etc.), departures from the approved version, poor quality of building materials, violations of the standards and production regulations through the course of the staff negligence, faulty operation of tools and equipment.

In the construction of oil and gas objects there is now a system available that is designed to control the quality even though it does not perform extremely well. It was created for managing administrative methods. In the market economy there should be a corresponding system of construction quality control in place. It is not well-rounded as of now and therefore all the current guidelines and recommendations relating to quality control can be applied in the practices of governmental controlling authorities, construction organizations and private companies [6].

Defects in construction are not legally defined. The end product is deemed high quality by default.

There are cases when there are violations in how the end product is delivered and accepted. This might leads to the following risks posed on the customer [10]:

— risks of getting the project work not finished completely;

— risks of violating the legal regulations;

as well as financial risks:

- paying for the work violating the health and safety regulations;
- paying the work that has not been finished.

Another important aspect of control activities of both the customer and contractor during the inspection of any implicit work performed, structures and areas of engineering networks onm oil and gas objects is the presentation. According to the Major Guideline RD 11-02-2006 "Requirements for the Composition and Order of Executive Documentation in Construction,

Reconstruction, Major Repairs of Objects of Major Repairs and Requirements for the Inspection of Works, Structures, Areas of Engineering and Technological Networks" (with changes as of October 26, 2015) contains the following: "The following is the subject of inspection…" Let us look at this in more detail.

The traditional long-established scheme of delivery and acceptance of construction production [11] commonly used in the entire construction industry is presented in Fig. 1.

Delivery – preliminary inspection – is control executed by an individual in charge of the construction in order to ensure that the works, structures, areas of engineering networks are in compliance with the project, regulative and organizational guidelines at this stage of construction and assembly and that they are ready to be evaluated and accepted by the customer.

We argue that presentation of construction production to the customer is essential for the contractor during the delivery and acceptance procedure and should rely on the State Guidelines (GOST) 15.309-98 "System of Development and Production. Tests and Delivery of Manufactured Production. Basics". Presentation should be documentary (preliminary written inspection, notice, report) and it is only following internal inspections conducted by those presenting this production for inspection. These comply with the requirements for implementing the quality management system according to the State Guidelines (GOST) ISO 9001-2011 "Systems of Quality Management. Requirements" and validation of construction control [1, 5]. The final presentation document with the report is filled in by the individual in charge of the contractor's construction control.

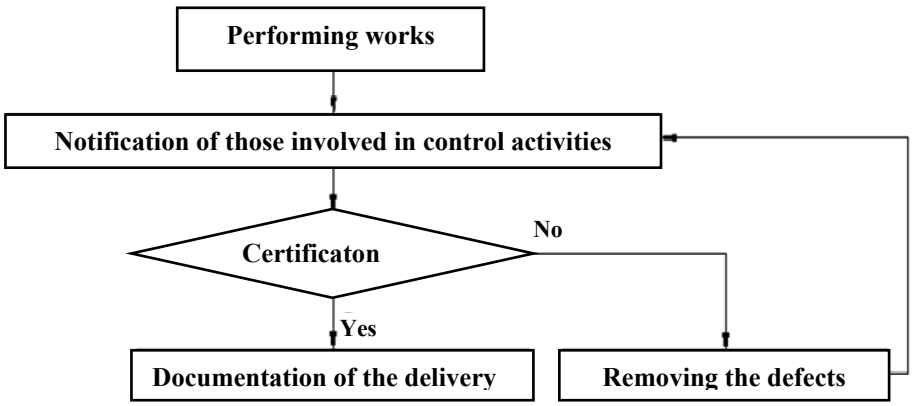

Fig. 1. Traditional scheme of the acceptance of a construction production

All of these including the contractor's internal inspection while preparing for the presentation of the work are reflected in the modified scheme of acceptance of works that was suggested by the authors and approved by construction control experts (Fig. 2).

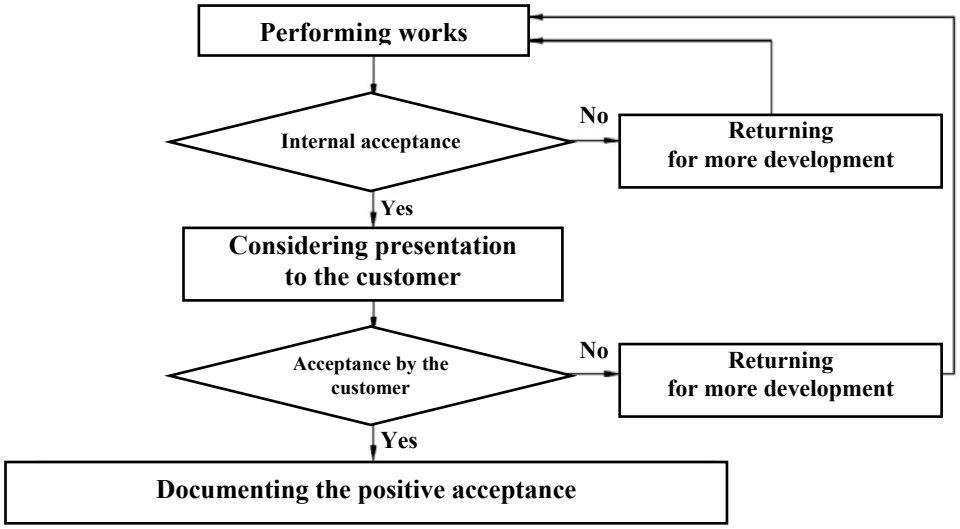

Fig. 2. Modified scheme of acceptance of performed works

Delivery and acceptance are certified by the customer in presence of an individual in charge of construction control as well as a representative of a construction control service or individual specialists running the construction and controlling the process.

Other individuals in charge can also participate provided they are granted these duties through the legal, regulative requirements or the customer's decision.

During the inspection (certification) the production for the presentation must not be developed, repaired, replaced in its composition and some elements unless specified by the production guidelines (as a note or references to other documents).

Positive certification is documented as an act and a representation document. Negative certification is documented as a representation document only (defects, acceptance decline). The authors believe that there is no need to document the entire range of defects as well as causes of acceptance decline.

The results of certification of the production should be deemed negative if following the certification it fails to meet any of the requirements specified in the technical guidelines for the corresponding category. We argue that the suggested activities allow for defect control of construction production. The causes of acceptance decline might be as follows [8, 9]:

— incorrect documentation;

— inappropriate workplaces and/or measurement tools for necessary measurements through the course of certification by the manufacturer;

— mutually agreed decisions that failed to be made (concerning health and safety, changes in the documentation, etc.);

— measures to detect defects during prior control that failed to be performed.

We assume that discounted fees might encourage shorter certification times, which is in agreement with the Civil Code (Article 12 and Part 1 of Article 723 of the Civil Code of the Russian Federation in the Edition of the Federal Law from March 30, 2016 № 79-FZ). Hence the first certification is paid for entirely and those to follow with increasing deductions.

Conclusions

The above delivery mechanism can be employed in the "customer — contractor" interactions on oil and gas objects as well as within a contracting company ("a construction control service — corresponding departments").

Unlike others, the algorithm of delivery and acceptance set forth by the authors (presented as the scheme, see Fig. 2) makes it obligatory to present the production for joint certification and in fact forces the contractor to exercise construction control and thus more responsibility to reduce the costs incurred by the customer.

Implementation of the construction control activities considering the above recommendations might benefit users in a number of ways.

Firstly, the acceptance is arranged by the customer and responsibilities and duties of those involved are specified in the corresponding requirements. The process is guaranteed to be objective, credible and entirely controlled.

Secondly, the contractor has to perform construction control and make decisions as to whether the conducted works, structures and areas of engineering networks are in compliance with the corresponding requirements.

Thirdly, the customer has at their disposal the documents to enable them to be in control of defects as well as to track how the technology, deliveries and documentation are arranged.

Note that running construction enterprises that work on providing the quality of oil and gas objects is challenging and daunting as it involves both extra research into legal, technical and economic issues. Therefore what we did in this paper was to state the problem and did not make it our task to cover all the aspects of construction quality.

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