Increase efficiency of a gas compressing facility in Oil and Gas Industry. Setting up an efficient design review session during a construction project

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Abstract: As most gas compression facilities in Romania are from the 60’s-80, there is an increased demand to increase their efficiency. The paper is meant to give general guidelines to manage the project and to know one’s importance in the project in order to have a good understanding of the actual steps involved in the gas energy efficiency increase from the technical, financial and managerial points of view.

Keywords: Oil and Gas Industry, Energy efficiency; Gas compressor station; project management

1. General context

As the oil and gas industry need of running and processing resources as efficient as possible is increasing year by year, Romanian gas treatment facilities are one of the main focus points of this optimization point considering most of them were built by late 80’s. The technology used at that time is old enough to become inefficient in 2021, in terms of operational, maintenance and energy supply costs.

There are projects which are aimed at getting the optimization done for this facilities, some of them by building new ones to support current production, others by building new ones and decommission the old ones from the start or after a period of time.

General contractors with experience in the industry are aiming to win the tender of an EPCC project or the industry known profile resources operator are following agreed procedures of existing frame contracts in order to start the works.

Considering that the national operators have fuel gas “in their yard” modernizing the facilities with gas compressing units driven by gas engines is a feasible option. For increasing the efficiency of a gas compressing unit a new construction project has to be put in place, therefore installing new equipment is necessary. After setting up the project plan, objectives and main tasks, the process optimization procedure has to go through few phases, starting with concept and continuing with important evaluation steps like Design Review procedure.
2. Scope of the project and the way forward

The main scope of the project is OPTIMIZATION. But in order to achieve this we have to go through a very pessimistic approach having our concept and design reviewed against multiple scenarios from which we can choose at least one feasible.

Starting with the basics for each construction project we have to have a design review exercise for which we need the following information:

- Project Name;
- Project Manager;
- Project phase;
- Workshop date.

The project is about construction of a compressing system that increases the efficiency of gas extraction and processing, to be supplied into the national transport grid at a pressure of ~40 bar. For this purpose, we need at least two reciprocating compressors and required utilities. When having in plan modernization, we should also consider the possibility of needing repairs of the existing pipelines.

Considering that most of the existing facilities are running with electric motor compressors, selection of the new equipment has to be made in accordance with what energy source we have available. In this case the natural resource operators have gas, therefore selecting a gas driven motor compressor could be the right choice.

The above mentioned decisions are being established after SELECTION phase during which a number of different scenarios were taken into consideration, analyzed financially and technically. The design review work can cover both compressors station scope but also the review of the pipeline replacement/repair design documentation.

3. Available documentation

For every workshop a set of documents have to be prepared by project stakeholders and discipline owners:

- Input Data Sheet;
- Simulation reports;
- Heat and Material Balance;
- Block Flow Diagram;
- Process Flow Diagrams;
- Piping andInstrumentation Diagrams;
- Functional Specification for Reciprocating Compressor;
- Concept Selection & Technology Evaluation report SELECT Phase;
- Site visit report and Kick-off Meeting report for DEFINE phase;
- Control and safety Architecture;
- Telecommunication system specification;
- Control and Instrumentation Block Diagrams;
- Other relevant technical documents.

In order to have the right picture of the Design Review session from the start, some initial clarifications have to be made:

- How the project is going to be executed – In house, EPCC, Frame-contract based;
  Depending on the option the team of engineers have to prepare different type of documentation.
- The type of documentation that will be analysed and the completion stage:
  o Block Flow Diagram, Process Flow Diagrams, Piping and Instrumentation Diagrams – 40% to 50%;
Compressor functional documentation - ~50%.

- What is the status of the overall project progress – usually at the Design Review point should be between 20% - 30% - this is a very rough estimation based on industry best practices, experience, but the project control documents can indicate exactly the status of the project at the workshop’s date.

4. Workshop participation – stakeholders

For the Design Review session a number of key stakeholders have to participate. This is to be considered as a minimum number and in case one of them cannot attend, it is preferable to reschedule the session.

Depending on the type of organization the list must include:

- Management representatives
- Technical advisors / authorities – Company TA’s
- Discipline Leads / Discipline specialists.

As an example below we have a proposed list of people that can participate to a standard Design Review session for a compressor station:

- Design review workshop Lead
- Concept Engineer
- Senior Department manager
- Project Management Processes
- Project Engineer
- Process Specialist
- Mechanical Specialist
- C&I Specialist / Engineer
- Electrical Specialist
- Engineering Team Lead
- Process Engineer
- Mechanical Engineer
- Instrumentation Engineer

5. Workshop record

5.1. Workshop overall activities presentation

After the Design Review process, it is recommended that a short overall project presentation to be held and all the equipment inside the compressor station have to be presented - utilities package has to be included.

5.2. Workshop records

5.2.1. General inlet data

The inlet data is used for design development and has to be checked against the available input data sheets, which is a register of checks:

- The indicated operating minimum suction pressure;
- The operating maximum suction pressure at the suction of the compressors during normal operations;
- The total gas flowrate for which the facility will be designed (Sm³/day);
- The nominal designed flow rate of the compressors package (best practices recommend that this value to be 60% from the total gas flowrate for which the facility will be designed).
At this stage separate investigations have to be developed and equipment vendors have to be contacted. We have to compare the required capacity from the project with standard compressors capacities available on the market in order to make sure the values are close and that we have at least two options. The total gas flowrate for which the facility will be designed has to be compared with the equipment capacity.

There is a discrepancy between the maximum operating pressures of the compressor station and the maximum operation pressure at downstream facility. As one of the examples in one facility in southern Romania:

- **Minimum** discharge operating pressure compressor station: 47 bar
- Existing pressure drop between compressors station and downstream facility: 3 bar
- **Maximum** operating pressure downstream facility: 40 bar.

As a general rule, the maximum operation pressure of the facility must be higher than the minimum discharge operating pressure of the compression station from which the pressure drop across the connecting pipeline is subtracted.

In terms of experience, during this Design Review session, it is important to raise this question: **How the upstream and downstream facilities are protected in case of this compressor station failure?** This is the subject of a separate review session called HAZOP – a structured and very detail-oriented examination of past, existing, and future processes with the scope of identification potential issues that can transform in risks for the personnel and/or equipment.

### 5.2.2. General inlet data

In this chapter the project team has to make sure the designed equipment can handle the process, from functional and failure point of view. Therefore starting with separator vessels, compressors, piping, pipeline, manual / automated valves, etc., all equipment specification must be reviewed.

The conclusions of this chapter has to include (but not limited to):

- Agreement on final equipment layout and configuration inside the facility;
- Failure scenarios and mitigation;
- Inquiry conclusions for the reliability of the equipment considering the maintenance plan.

### 6. Conclusions

The design review workshop must reveal the fact that the design phase is handled correctly and that the project in going in the right direction. The session can be adapted to any type of organization and can also include a design-to-value component in which for each analysis it is introduced a product cost management to optimize product cost and value in the same time. This can impact or not the stakeholder matrix for this workshop.

This step has to consolidate the following main objectives:

1. Gas treatment process is done in the most efficient way as per initial Scope of Work;
2. The quality of the final product is guaranteed as being per Client’s present specification;
3. Reducing costs with buying power energy from national suppliers and start using own resources – well gas.

A good professional, irrespective of the role in the project should keep in mind the above steps in order to have a good collaboration with the other parties involved, to know its importance in the good flow of the project and to be able to evaluate the results (both tangible and non-tangible) in order to better improve future work.
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