Increase efficiency and process optimization for an existing gas compressor station unit in Oil and Gas industry

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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 explains researches on energy, economic and functional efficiency of equipment and processes during the modernization of a compressor station in oil and gas industry. It is meant to serve as a general guide for methods and procedures usually used in the industry in Romania, to improve the efficiency of an existing compressor station.

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

1. General context
Considering the international recommendations regarding the use of natural resources and considering the requirements of Romania’s top Oil & Gas operators (e.g. Romgaz, OMV Petrom), the need of a more efficient way to exploit these resources has increased from one year to another.

The EU legislation required that one cannot use more than 1.367MWh/MWh or 1.418M/MWh in case of Romania to generate 1MWh of final energy. Otherwise, the difference should be obtained from other parts of the country. The European Directive 2012/27/EC was integrated in the national legislation through Law no 121/2014. The consequence was a need for efficiency, for new investments that would improve the present facilities – gas compression including.

We will go on discussing how this applies to the gas that separates from the crude oil right after extraction (the third component resulted after oil and water).

In Romania, gas resource exploitation is coming from the gas surface facilities and were mostly built between 1960 and 1980 (estimated 70-80% from Romania’s total facilities). In 1965, Romania became the first European country to a compressing station on a main pipe, at Bățani, and it was equipped with turbo-compressors. Due to high demand of gas, between 1965-1985, 6 compressing stations were added on the transport pipelines. Nowadays, they are quite inefficient considering the resources needed to run such old equipment in terms of energy, maintenance costs and lack of equipment parts on the market.

Getting to the bottom point, efficiency increase of a gas treatment facility can be done two ways: by building a new facility that supports the old one for a period until decommissioning, or by building a new one with immediate termination of operations of the old one.

2. Methodology and optimization
For more than 95% of the cases, the construction of such facility is being done in a public tender system and contracting an EPCC General Contractor (Engineering – Procurement – Construction and Commissioning), for services like Design, Civil Construction, Works supervision, etc.
2.1 Identification of the main need and basis of design (general gas flow in the facility, process and input data)

One of the main objectives of this type of project is to increase the delivery pressure of the gas from a lower to a higher pressure by gas outlet pressure rise. As a general example, most of the gas compressing units are using old electric compressing units that do not have the capability of rising the outlet pressure more than 25–40 bar. New generation of piston compressors can process and rise the outlet pressure up to 63 bar, therefore this new technology can increase efficiency in the surface facility. In addition, companies such as Transgaz require 63 bar in pressure in order to be able to enter into a delivery contract with them.

A second objective can be ensuring the operation safety in order to meet the Company’s production and gas sales targets. Newer equipments are less likely to suffer malfunctions that result in temporary business cessation.

2.2 Assessing the current situation and process

In Romania, it is customary for the gas operators to bring the gas produced by their own wells to surface facilities in order to process and deliver a higher quality product – either to a client or to use it for internal purposes.

An example of this type of surface facility can be a compressing unit station and/or a dehydration unit. The second is used in the last stage of the gas processing process, in order to increase the delivery quality.

Gases coming from a group of wells are using existing pipelines (with diameters from 3” to 12”) that can have lengths from few hundred meters to tens of km are feeding a separating unit located in the existing separating unit.

After separation the gases are compressed by electrical compressors from 7 ÷ 9 bar up to 28 ÷ 40 bar. After first compressing stage, the gases enter in a second separation stage by a horizontal/vertical separator and being sent to the dehydration unit before final delivery.

In this stage the identification / assessment of the following existing systems has to be done:

- Existing power supplies (what kind of energy is used (electrical, gas)? where does it come from? How much does it cost?);
- Utility systems (fuel gas, instrumental air or nitrogen networks);
- Firefighting systems (foam extinguishers, powder extinguishers, firefighting equipment cabinets, gas detection systems and sensors);
- Control systems (automatic / manual).

2.3 Process optimization

The main reasons for process optimization are:

- Increasing the quality of the final product
  In general, the top Romanian players are selling most of the product to the national gas distributor, TRANSGAZ, which has strict quality requirements that are being updated each year. Top KPI’s are:
    ✓ Increasing the outlet gas pressure
    ✓ Drying the product and removing impurities in a higher percentage
- Increasing the efficiency of the process
  Using the existing equipment configuration can be highly expensive in the current context when companies have to buy electrical power energy from the national suppliers. In addition, it is cost efficient to use for gas compressors gas as fuel considering they have the product from own exploitation. Another reason is the fact that the life-cycle of the old compressors is at the end and their maintenance costs are quite high.
2.4 New process description

Low pressure gases coming from the group of wells will enter the compressing station in a horizontal separator in order to retain a volume of slug (gas bubbles).

Figure 1 – All three – stage separators from a Compressing Unit Station – modernizing project in Romania

After separation gases will be routed to the new reciprocating gas compressing units in order to increase pressure as per initial requirements. At this point the gases will enter a second separation phase and will be secondly compressed up to 47 bar by the compressing units (can be one or more units that work in parallel). The compressing units will be gas engine drive.

Figure 2 – One of the two new gas compressor (piston) from a Compressing Unit Station – modernizing project in Romania

After this stage the gas will be cooled down by the cooling unit and the last accumulated liquid will be removed by a scrubber (separator). As a general practice all the equipment above is included in the compressor package of most of the suppliers. After final compressing stage the gases will be again be separated before being sent to a dehydration unit and to final delivery.

2.5 Basis of design

Before the kick-off of any project specific activities, the project teams does an extended analysis in order to conclude what resources are necessary in order to implement this optimization process. The success of any project is directly proportional with the quality of the design basis that was taken into consideration.

This basis has to include the following factors and analyses:

- Codes, Statutory regulations, Standard and Guidelines for all disciplines. In general, the local statutory and legislative regulations have the highest priority. However, the project team should not forget that usually the client has its own internal standards that need to be considered (as of the design date).
- Units of Measurements. This part defines the agreed international System of units that will be used for all design activities.
- Environmental Data:
Climatic data. The environmental loads and values (wind load, snow load, thermal action, frost depth, and rain fall) will stand for development of Project’s detailed engineering phase, in full alignment with standards (national / international);
- The regional climate.
- Frost depth
- Seismic information
- Geological and soil specific information
- Emission restrictions.

- Design capacity
  - The maximum design capacity of the new gas compressing station aligned with the future production profile forecast for the region
  - The yearly turndown percentage of the facility

- Overall design life of the facility and as per equipment:
  - The design life of new equipment shall be (starting with FAT’s) for at least 25 years.
- Location of the facility
- Gas composition and characteristics
- Gas flowing conditions and regime
- Equipment configuration in accordance with the optimization process
  - New / existing and relocated equipment has to be taken into consideration
- Operating parameters
- Vent / Drain systems for at least two scenarios
- Design philosophies for all disciplines

3. Conclusions
How can we use the past and present experience in increasing the constructions works efficiency and to ensure that the facilities are being highly efficient in the future?
- Having all main important focus points and analyses on the table, running such project could run as efficient as possible, having all fundamental and hybrid researches available in one place;
- Having a pragmatic approach towards Equipment selection. This can make a difference between success and failure therefore making this selection considering all the utilities and maintenance services available will put the sustainability of your project in a safe place.
- By having always the big picture in one place together with all the up-to-date production forecasts aligned with your process optimization.

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