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THE NATURAL GAS PRESSURE AS A MAJOR COMPONENT FOR TO THE CUSTOMERS

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Abstract: Gas pressure represents and important quality parameter associated with traded natural gas. Assurance of correct pressure for the equipment and installation engineering process in limit terms generates multiple troubles to the production, transportation, underground storages and distribution operators and to customers at the same time.
Pressure decreases determinate an increase of gas flow speed, an decrease of gas separation and filtration efficiency, running out of equipment, increase of energetically consumption for the gas sector operators, a wrong natural gas flow measurement and not lastly makes serious material prejudices supported by all consumers with social reflection and without competitive Romanian products.
Pressure decreases at customer's side determinate an increase of gas flow speed, decrease of natural gas separation and filtration efficiency, running out of equipment, increase of energetically consumption for the gas sector operators, a wrong natural gas flow measurement and not lastly makes serious material prejudices supported by all consumers with social reflection and without competitive Romanian products.

Key words: flow, cargo, measurement, quality parameter, pressure

1. PRESSURE EVOLUTION

The natural gas pressure has progressed at the production point during the years 1950 – 1985 (for methane gas fields in the Transylvanian Basin and beyond the Carpathian Mountains and for the oil associated gas fields) as follows:

- at the "hole top", between 210 bar to 25 bar;
- at the production – transportation activity interface, as follows:
- low-pressure manifolds (from 25 bar to 7 bar) for transportation to close customers (≤ 30 km);
- middle pressure manifolds (from 40 bar to 15 bar) for customers located at $30 \div 80$ km;
- high-pressure manifolds (from 65 bar to 25 bar) for customer located at $150 \div 350$ km, assured by pipeline supply of natural gas.

Before delivery to the transportation sector, the natural gas was separated from the liquid impurities at the wells and manifold fleet. The mainly effect was the cryogenic pressure drop effect in the nipple and square valve of the production head in separators and reducing installation fleets. The natural gas was also separated from the mechanical impurities entrained from the rock storage layer, dried for water vapour retaining by dehydration installation ordinarily using solid desiccants (by adsorption) etc. After treatment, the natural gas was measured for delivery to the transportation operator.

In many cases, the long distance transportation requirements have enforced gas compression in the methane and oil associated gas fields as far back as the years 1955 – 1970, thus allowing pressures of $\geq 45 \div 50$ bar at the input points of the transportation subsystems.

The gas compression in the production units summarizes at the end of the year 1988 more than 150.000 HP in over 30 compressor station fitted with reciprocating, electro and turbo. Simultaneous, starting with the year 1965 on the transportation system was commissioned 10 compressor station equipped with reciprocating compressor and mainly turbo compressor, summarizing more than 90.000 HP.

As reference point for the importance given to the pressure parameter, we mention that during 1977 – 1980 in the production and transportation system at the output point of the south-east transportation system of the underground storage ring ϕ 28''around Bucharest, pressures limits of $38 \div 42$ bar at 6 a.m. and $8 \div 12$ bar at 10 p.m. were achieved. This fact together with the gas stored generally in the last third part of the pipeline to cover the peak consumption especially during the cold days of the winter season.

Likewise, due to the stability of the exploitation behaviour at inputs of the distribution networks and at the industrial platforms located far away from the gas sources, the minimal pressure before the regulating and measuring installation was $\geq 5 \div 8$ bar (during peak hours of the cold season), providing supply after regulating (outside of some hazardous situations) of $4 \div 6$ bar.

The enforcement of the gas extraction rate during the years 1975-2001 and at once the pronounced misbalance between the decrease of new gas source discoveries and the growing extraction can be transformed into a final recovering rate of over 85% (after year 1995). Starting from the simplest mathematic model $P_{strat} \times Volum_{strat} = ZRT$, it results that for the most gas fields with no contour water pushing, the pressure has fallen down under 10-35 bars and at this values, the high energetically consumption has to be taken into account, due to the additional stage compression (about 400 m^3/1000 HP/h $\approx$ 1000 USD/1000 HP/day).

Basing on the above-mentioned conditions, at the level of year 2002, the pressure at the input points of the transportation system rarely reaches during the winter season 25-35 bars. The pressure reaches at the input points of the regulating and measuring stations to the distribution operator and industrial platforms, even they are not at the pipe line end, was only 3-6 bar, and at peak hours of the winter season 1-2 bar. The derived consequences after regulating and measuring are low pressure of $\leq$ 0,5-1,5 bar and more enabled by pressure drops in the distribution system at users (a lot under the minimum operational pressure for domestic and industrial users going until to self stop of gas supply or stop command ordering) and in some cases gas supply without any regulating and measuring.

2. THE INFLUENCE OF GENERALIZED PRESSURE DROP AT THE PRODUCTION OPERATOR AND ALONG THE TECHNOLOGICAL FLOW TO THE USERS AND THEIR CONSEQUENCES TO THE CARGO PROPERTY OF THE NATURAL GAS

The influence of generalized pressure drop at the production operator and along the technological flow to the users has wide consequences to the cargo property of natural gas. Further, we will analyse these consequences for different natural gas market parties:

- **At the production operator**

It is needful to analyse following views:

a) Gas quality

Starting with the relation

$$Q = S \cdot P \cdot V\,, \qquad (1)$$

where:

Q = natural gas flow (m^3/s);

S = section (pipeline, filters, separators, absorbers etc) (m^2);

V = gas flow speed (m/s).

Pressure drop enables speed increasing with following consequences:

- exceeding of the optimum value of 3-5 m/s for separators, filters and absorbers;
- non-compliance in the pipeline joints of different technological installation and in the manifold pipelines of the 20 m/s limit;
- liquid plugs random entrainment stored in the lower part of the pipelines by increasing speed and short time variation of the speed in the pipeline.

Missing a relevant ΔP leads after the production head to a sensible diminution of the cryogenic liquid separation until complete cancellation.

Basing similarly on the pressure drop and in consequence on the flow speed increasing, the dehydration station with solid desiccants (adsorption) marched out of the operational engineering parameters and in addition due to they drop pressure generation of 3-3.5 bar, their stopping was actually disposed.

In conclusion, the natural gas supplied by the production operator is not adequate as quality (missing free liquids, assuring a certain dew point, collecting solid particles, etc.) and treatment technology appropriate to the low-pressure condition is compulsory to be used.

b) Increasing of energetically consumption

The compressor station built for certain parameters (flows, pressures, gas quality) does not correspond anymore to the present situation being necessary to:

- package upgrades with compressor cylinder of greater diameter;
- use of serial compression using more stations;
- decreasing of package efficiency;
- premature tear and wear of the compressor cylinder parts due to the improper gas quality;
- non-using in present of complete compressor station or packages of reciprocating, electro or turbo compressors located in other stations.

The result of the pressure drop for the compression process is the increasing consumption per installed HPh and especially per 1000 m^3 produced and supplied gas to the transportation operator without like the compression process benefits from the required carriage pressure

For instance, for the over 150.000 installed HP, even considering an simultaneous coefficient of 0,5%, for a price of 100 USD/1000 m^3 results a monthly energetically cost of 150.000 HP $\times$ 400 m^3/1000 HPh $\times$ 100 USD/1000 $m^3 \times 24 \times 30 \times 0{,}5$ = 2.150.000 USD/month.

3. MEASURING THE PRODUCED AND TO THE TRANSPORTATION OPERATOR SUPPLIED NATURAL GAS

Any indirect (with panels and gas nozzles) or direct (with turbine, ultrasonic, vortex etc.) measuring system regardless the costs and performance of the compound devices is designed only for *one phase gas flow* determination, namely gas with no free liquid and solid suspensions.

The measuring systems are designed for a certain pressure domain and those variation allowances, which are meaning that in most cases the existent measuring panels, are not anymore adequate in point of errors and flow determination quality.

On the other hand, the measuring systems are aggressed by a mixture of solid, liquid particles and acid fractions leading to:

- deposits on the gas nozzle (nozzles, calibrated discs);
- nozzle erosion and corrosion;
- mechanical tear and wear and even destroying of direct measuring equipment;

Improper volumes or metric gas flow measuring, is affected negative by the non-determination of the gas composition, respectively the energetic contents and therefore chromatographs are needed at all delivery – acceptance points, production / transportation operator where the flow exceeds 20.000 ÷ 30.000 m^3/h.

In fact, the distribution accumulates all non-regularities from the natural gas production and transportation operators, to which we can summarize the chaotic network development between the years due to the increasing domestic consumption and rerouted gas supply (from centralized heating supply to regional and individual heating supply).

Therefore:

- the existing regulating and measuring station are outside the operational engineering parameters and in most cases measuring is not accurate and even replaced fiscally by *“agreements between parties”*;
- gas losses in distribution increases highly;
- the operating pressure at different domestic and industrial users is not ensured with consequences to the efficiency decreasing even if the beneficiaries are paying a relative normal quantity;
- missing natural gas during cold season and peak consumption hours for the users connected at the limits of the distribution network.

4. CONCLUSIONS

1. Amalgamation of improper gas quality with direct consequences to calorific power and non-insurance of operating pressure and non-accurate measuring leads to a serious material prejudice supported by all domestic consumers, assimilated consumers and industrial consumers with social reflection and missing competitive Romanian products.
2. For the same reason proper measuring of transported, distributed and consumed natural gas, whatever the flow determination system is, performances and installation costs are disputable with influences on technical and financial balances of seeming and real “losses”.
3. By systematical non-compliance and missing of coercive measures, the natural gas contracts between parties (excepting the import and transit contracts) become fictive and formal conception.
4. Replacement of technical norms, standards, contracts and other legal provisions with “disposals and agreements between parties” related to financial values, with consequences to consumers and environment protection, human being and material protection etc. is unreasonable, damageable and illegal, especially when we refer to an important **national property** administrated by 100% STATE owned companies.
5. Non-compliance of some parameters especially the natural gas *pressure* is actually desired by some exploitation structures, in many cases to avoid to raise the evidences of precarious technical conditions of the pipelines due to missing investment, repair and maintenance activities which describes significantly the years 1996-2002.

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