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GIE Position Paper on Gas Quality

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What is GIE?

Gas Infrastructure Europe (GIE) is an association representing the sole interest of the infrastructure industry in the natural gas business such as Transmission System Operators, Storage System Operators and LNG Terminal Operators. GIE has currently **70 members** in **25 European countries**.

GIE is a representative organisation towards the European Institutions (European Commission, European Parliament, Council of the European Union) as well as the European bodies of regulators (ACER, CEER) and other stakeholders.

One of the objectives of GIE is to voice the views of its members vis-à-vis the European Commission, Regulators and other stakeholders. Its mission is to actively contribute to the building of a single, sustainable and competitive gas market in Europe underpinned by a stable and predictable regulatory framework as well as by a sound investment climate.

Introduction

Gas quality plays a crucial role for the interoperability of gas systems and thus the free flow and trade of gas. Currently, there exist different natural gas qualities across Europe depending largely on the different sources of gas. Furthermore, with the declining European natural gas production and the expected increase in demand in the coming decades, Europe's import dependency will most likely grow, particularly for power generation where natural gas has proved to be the cleanest, most efficient and versatile of all fossil fuels.

The interconnectivity of existing transportation systems, the ability of gas storage facilities to modulate demand and the ability to import LNG from a wide range of sources will all play very important roles in providing security of supply throughout Europe.

This existence of disparate gas qualities has received increased attention in the recent years mainly due to the integration processes of the European gas market. Moreover, with the envisaged development of renewable energy sources, including those in gaseous form such as biomethane[1], synthetic natural gas[2] or hydrogen, the topic of gas quality will further gain in importance. It is worth noting in this context that biomethane is considered to have the highest potential impact in the energy mix in the nearest future, largely due to the political support that it receives.

The need to develop gas quality standards in Europe to achieve market integration and to ensure integration of renewable energy sources has been recognized by the European Commission, which is

[1] Biomethane: generic term used to refer to gases produced from both biological and thermochemical processes. The biological processes are based on upgrading biogas produced by anaerobic digestion of municipal waste streams, process residues, agriculture waste streams and energy crops such as various types of grasses as well as landfill gas by removing the carbon dioxide and other contaminants from the biogas. In thermochemical processes biomethane is produced by the catalytic treatment of synthesis gas downstream of biomass gasification processes

[2] Synthetic natural gas: gas produced from carbon-containing masses through gasification and methanation. This term may also mean gas produced from excess energy (e.g. surplus wind or solar energy) and water through a process of electrolysis and subsequent methanation (the concept of „power-to-gas").

pursuing harmonization of gas quality parameters at EU level[3]. To this end, the Commission has launched two processes by issuing Mandates to the European Committee for Standardization (CEN):

- CEN Mandate M/400 of 2007 to draw up standards in the field of gas qualities. The Mandate consists of two phases: the first one consists in analysing the impact of gas quality fluctuations (Wobbe Index and density) on gas appliances falling under the GAD; in the second phase EU standards for both combustion and non-combustion parameters will be developed.
- CEN Mandate M/475 of 2010 to draw up standards for biomethane for use in transport and injection in natural gas pipelines.

GIE supports the general objective of the work in the area of gas quality standardization and recognises that harmonising gas specifications across the whole of Europe is challenging. However, harmonised specifications across the EU are key to creating the effective interoperability of networks facilitating a free trade of gas by lifting local gas quality barriers. In addition, such specifications need to be wide enough to not induce excessive treatment costs, but trying to avoid excessive appliance replacement, as these costs would ultimately be borne by end consumers. However, it should also be stressed that this work should ensure that safety and integrity of the gas system and end consumers' gas appliances are maintained. Any change may impact safety standards and must be thoroughly assessed before being implemented. In particular, with regard to renewable energy sources, it is important to underline that their integration will rely on the existing gas infrastructure.

Gas quality and gas infrastructures

Gas quality plays a major role for the operability of gas infrastructures. Operating conditions are completely different for each kind of gas infrastructure and this should be carefully taken into account.
The quality properties resulting from a mix of any renewable gas with natural gas will necessitate an in-depth assessment against the possible effects on gas infrastructures. Transmission systems and underground gas storages in particular may be exposed to a wide range of components that have been introduced for instance through the combination of biomethane injection with other natural or added components of natural gas.

The sections below discuss the components that need particular consideration for each kind of gas infrastructure (underground gas storages, LNG terminals and transmission systems).

GIE would like to highlight that parameters such the methane number, propane equivalent, ignitability and laminar combustion are very specific for a small part of the gas sector and not representative of the entire EU market. Therefore, these parameters should not be included in the future gas specifications since they will only bring more restrictions which are not required. Moreover, it should be noted that the methodology for the calculation of methane number varies between Member States.

Critical Parameters of Gas Affecting Underground Gas Storage Facilities

The proper operation of both surface and subsurface equipment of the facility as well as the underground reservoir itself depend largely on the properties of the gas which is injected into the facility. While the behaviour of storage facilities is well-known and proven in the case of injection of natural gas, the effects of the injection of renewable gas such as, biomethane, synthetic gas or

[3] It has to be mentioned that changes in gas quality would also require new standards for measurement devices and procedures.

hydrogen necessitate careful analysis. This is because such gas may contain certain components or critical concentrations thereof which can present considerable technical risks for a storage facility including its installations and the reservoir itself.

The following section discusses various components whose presence or high concentration in the gas injected into a storage facility may exert a significant impact on both the subsurface or surface equipment.

A distinction needs to be made between components which can already be found (to a larger or lesser extent) in natural gas but whose concentration may vary significantly in other types of gas and components which are normally not found in natural gas but which may be present in other types of gas. For the purpose of this paper we will speak of “unconventional concentration” of certain “conventional” components in the first case and “unconventional components” in the second case.

❖ **Unconventional concentration of certain conventional elements:**

1. Oxygen

When extracted, natural gas is oxygen-free. This is because it is formed in underground strata under anaerobic conditions. Nevertheless, oxygen can be measured by TSOs at some interconnection points, albeit at very low concentrations, as a consequence of:

- quality adjustment (non-cryogenic nitrogen injection)
- desulfurization of gas with the use of processes requiring oxygen
- works on pipelines.

On the other hand, in the case of biomethane, the concentration of oxygen can be significantly higher than the levels which are currently found in natural gas. As a result, when injected into the high pressure transmission network or recompressed from the distribution grids biomethane can dramatically increase the oxygen content of gas with potential impact on storage facilities, in particular:

- increased corrosion of both surface and subsurface installations,
- iron(oxy)hydroxide precipitation with associated pH-reduction (corrosion enhancement, especially in combination with organic acids) and accompanied mineral weathering
- accelerated creation of elementary sulfur in the presence of H_2S, which may negatively affect the characteristics of the storage facility, leading to pore clogging of the underground or to sulfur deposit on valves, filters and turbines on the surface equipment.
- reaction with production chemicals (e.g. with glycols used in dehydration units to promote enhanced glycol-aging)

2. Sulfur components

Although sulfur components can be found in some cases in natural gas, their concentration is usually limited.

The presence of sulfur components within a storage reservoir may generate many different reactions with other substances (oxygen, hydrogen) for example to H_2S or cause changes of the pH-level and feeding of bacteria. This will ultimately depend on the geochemical and geophysical conditions of a facility.

With the increased concentration of sulfur components, the unwanted reactions described above can be exacerbated. This can be the case when injecting biomethane, which typically includes significantly higher concentration of these components.

As the usage of (sulfur containing) odorants is handled differently all over Europe, combined with the possible injection of biomethane from distribution to transmission networks the issue will require indepth assessment.

3. Carbon dioxide

Natural gas contains small amounts of carbon dioxide. However, carbon dioxide is one of the principal components of biogas. According to Marcogaz (WG Biogas-06-18), the concentration of carbon dioxide in biogas is generally around 40%.

Given the specific operating conditions of storage facilities, carbon dioxide can cause corrosion. This is due to the humidity in storage reservoirs which is generated by the presence of water in the immediate geological environment. With the elevated levels of carbon dioxide in biomethane as compared to natural gas, its injection could significantly exacerbate the process of corrosion.

4. Biological agents

Both natural gas and biomethane contain microorganisms. It is recognized that microorganisms are present in natural gas, but their nature can be different from those of biomethane, therefore this issue should be addressed.

Currently little is known about differences in microbial strains and quantities. Growth and reactions of microorganisms, especially under storage operating conditions (humidity, temperature, pressure, pH-factor etc.) and hence are unpredictable and must be carefully investigated further.

Nevertheless, it is clear that microorganisms and the products of metabolism (i.e. organic acids) may influence the quality of natural gas and impact on the storage facility in a number of ways:

- bio-clogging of natural reservoir strata
- bio-clogging of technical facilities (i.e. filters)
- damage to the reservoir rock due to change of the pH-factor
- corrosion
- contamination of processing fluids
- changes in gas quality (causing sour gas)

5. Hydrogen

In the context of the development of renewable energy sources the potential increased usage of hydrogen and its possible injection into gas infrastructures will need to be analyzed as it may have an impact on storage facilities. In particular the following technical limitations have to be assessed:

- stress cracking at steel installations, which might potentially occur under typical gas storage operations (cycle pressure loading)
- possible substrate for undesired bacteria
- possible production of organic acid or hydrogen sulfide
- possible undesired impact on gas engines

❖ **Unconventional elements:**

6. Siloxanes

Siloxanes are present in biomethane generated from solid waste or sewage treatment.

In the combustion process, siloxanes are oxidized to silicon dioxide which forms deposits on internal surfaces, in particular pistons and cylinder heads. This, in turn, damages gas fuelled engines and turbines which are used by many UGS for the operation of the facility (e.g. compressor stations).

7. Ammonia

Ammonia is another component which can be found in biomethane and which presents a corrosion risk. This risk is of particular relevance in storage operating conditions characterized by the occurrence of humidity which exacerbates the corrosion process.

8. Halocarbons (Organo Halides)

Natural gas does not contain halocarbons. However, these are normally present in biomethane generated from solid waste treatment. The use of gas containing halocarbons for the processes associated with storage facility operation (e.g. to propel compression stations used by many UGS) may present a safety risk. This is because when combusted, gas containing halocarbons may generate dioxins and furans.

9. Poly aromatic hydrocarbons

As in previous cases, poly aromatic hydrocarbons may present a technical and safety risk for the equipment associated with the operation of a storage facility. In particular, they can cause damage to seals in valves and generate soot when combusted. Similarly to the other mentioned components, poly aromatic hydrocarbons can be found in biomethane.

10. Carbon Monoxide

Biomethane when generated from the thermal gasification of biomass amongst other processes contains a significant amount of CO, which is very toxic and whose release, especially in small confined spaces, can increase safety risks.

11. Trace components/Impurities:

Biomethane could bring additional dust and particles into gas systems, which can clog the filters that are used to protect the equipments as well as the valves and turbines.

Critical Parameters of Gas Affecting Transmission Systems

Transmission systems may be exposed to as wide a range of components as the underground gas storages. The previous section gives information of various components whose presence or high concentration in the gas injected into the transmission network may have a significant impact on the pipelines and the rest of the equipments (valves, compression stations, etc).

Critical Parameters of Gas Affecting LNG Terminals

Although the operating conditions of LNG terminals differ from those of underground gas storages or transmission pipelines, just like in the case of these two types of infrastructure, gas quality plays a major role for the operability of LNG regasification terminals.

The following section discusses the elements that need particular consideration for LNG Terminals.

1. Wobbe Index

Countries with a narrow Wobbe Index range will be limited on the type of LNG received or require major investments in Wobbe Index correction facilities, adding additional costs into the value chain and generally increasing costs to end users. This could act to reduce a country's competitiveness in the global LNG market, although investment decisions will be taken on a broader range of issues than solely the gas quality specification. A Wobbe Index range that is as wide as safely possible should be implemented to promote Europe's ability to receive both rich and lean LNG, thereby minimising additional processing expense

2. Oxygen

If Wobbe Index adjustment is required then air or nitrogen-enriched air is generally used thus introducing oxygen to the gas stream. Any new specification should take into account the increased levels of oxygen in the gas resulting directly from the Wobbe index adjustment. However, this should be without prejudice to the potential impact on other infrastructures.

During the development of individual component specifications in CEN TC234 GLE will actively participate and may develop further positions to supplement this Position Paper.

Conclusions

GIE supports the general objective of the European Commission in the area of gas quality standardization, as gas quality plays a major role in the interoperability of gas systems and the free flow of gas across Europe. Consequently we believe that pan-European harmonization or regional harmonization of gas quality specification should be pursued.

Nevertheless, revised gas quality specifications, if not compatible with certain operating limits, may have a lasting negative impact compromising the use of gas infrastructures. As mentioned in this position paper, the impact can vary between infrastructures and needs to be analyzed in depth.

The European Commission has set out a schedule for the development of new gas specifications. Once established, Member states should adopt the new specifications or adopt a gas specification with a range as broad as safely possible for each component in order to:

- Maintain safety standards in the gas industry.
- Improve market connectivity and ease of doing business in Europe, promoting a single European gas market.
- Minimize additional costs in the gas supply chain.
- Increase security of supply by providing access to as many sources of gas as possible.
- Increase Europe's competitiveness in the global gas market.

GIE recognises that harmonising gas specifications across the whole of Europe will be challenging. If a single European specification proves impractical to implement in one go then a regional approach should be considered as an appropriate starting point.

Furthermore, GIE would like to highlight that where gas quality treatment is required in the EU it is necessary and very important to define responsibilities for the processing and delivery of gas within specification. If the operator of any infrastructure is obliged to invest in such gas treatment facilities (i.e. costs of blending facilities, operational costs etc.) then the recovery of the associated cost should be ensured independent of the use of these facilities.

In the case of renewable gas whose use is expected to increase in the near future and which could have an impact on the existing infrastructures, the way forward should be to ensure that the quality parameters are adjusted upstream at the production stage so that the resulting product can be used without posing necessary technical or safety risks to the infrastructure on which it will rely.

Having said the above, GIE would like to stress that any work on gas quality standards, including for biomethane and any other type of renewable gas, should be carried out with a view to defining acceptable levels of all components which may influence operating conditions.