EUTurbines Position on
Impacts of variation in European H-gas quality

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In short:

EUTurbines supports the idea of improving the security of supply on the European gas market by increasing the number of sources for gas in Europe and by creating a real European gas network. It is recognised that this includes gases of a diverging composition.

To ensure that gas turbines operate efficiently, safely and within the allowed emission limits, it is essential that the composition of gas reaching the gas turbine stays stable within a defined bandwidth for which it has been designed and tuned for. Any exceeding values will lead to the need of hardware adaptations, so that the performance and efficiency of the turbine is not affected. Any unnecessary costs due to the need to adapt the technology to variations in the gas quality have to be avoided or minimised.

Regionally different qualities should continue to be possible in the future. In the same way, existing good practices should not be forgotten and should continue being used.

Framework

EUTurbines is the association representing the European gas and steam turbine industry. The gas turbines manufactured by its members are used in gas-fired power plants, industrial and mechanical drive applications (i.e. in the gas transmission network). Manufacturers of turbines plan, build and sell complete power plants, mechanical drive and industrial solutions, but they do not operate these units.

Gas turbines used in power generation include the generation of electricity, but also combined heat and power generation, where the heat is used in district heating or industrial applications. The gas that is being burnt may be natural gas, but also waste gases or syngas.

Gas-fired power plants are tailor-made

Gas-fired power plants using turbines are large installations. They are designed and built based on detailed specifications provided by the operator of the future plant. In these contract details, a defined composition of gas is described. Turbine manufacturers are able to design optimised plants for a wide spectrum of defined gas qualities (e.g. a high or a low Wobbe-Index value), but there can be technological specifications linked to each specific gas quality.

Therefore, the variations in gas quality that a specific plant configuration can handle after its completion – without impacting the performance of the gas turbine – can be limited. It is possible to adapt an existing gas-fired power plant to a different gas specification – through hardware modifications, such as in the combustor. However, this means a modification of the plant set-up and additional costs.

Gas Turbines and the Gas Transmission Network

The impact of variations in gas quality does not only affect gas-fired power plants. Gas turbines are also used in mechanical drive applications (i.e. compressing gas for its transportation in the transmission network). Problems caused to gas turbines in the gas network infrastructure due to varying gas quality can have an impact on the security of gas supply, and consequently, on the security of electricity as well as heat supply. Interruptions in the gas transmission network could affect the energy production of gas-fired power plants putting at risk the stability of the grid as well.

The cost challenge to ensure the stability of the European electricity grid

Europe's energy system is in transition. The share of variable energy from wind or sun is growing, the pressure on thermal power plants as well. Gas-fired power plants are among the most efficient plants and have low carbon emissions. Due to their fast start-up and shut-down times, they are ideal to back-up variable renewable energy sources. The operation as back-up plants implies a limited number of operating hours, making it challenging to recuperate the fixed costs in reduced running hours.

The owners of almost all turbine-based gas-fired power plants in Europe, therefore, have difficulties to run these plants profitably. As a consequence, many modern, highly efficient gas turbine power plants are being mothballed due to a lack of profit for the operators – despite the many technical and environmental advantages that they offer.

Gas specification considerations

It needs to be kept in mind that gas turbine manufacturers consider their fuel gas specifications and product suitability for different gas qualities as sensitive and confidential information. There are differences between individual gas turbines regarding the suitability of certain fuel gases and the capability to handle those might, therefore, create a competitive advantage. Due to the commercially sensitive nature of the topic, EUTurbines is not in a position to recommend any other values than the mentioned below.

Wobbe-Index

The Wobbe-Index in itself is not problematic: gas turbines can be adapted to a specific quality within a wide range. The challenge for gas turbines' performance comes not from a wide spectrum of possibilities – adaptations can be made – but rather from variations to the gas quality that was predefined.

Since the current standard EN 16726 does not contain the Wobbe-Index, CEN has been mandated to investigate this area and come with a pre-normative conclusion (activities within the CEN SFGas WG GQ Study). Gas turbines manufacturers are involved in the discussions.

If within the current EU security of gas supply framework, the need to have a Europe-wide gas quality definition – Wobbe-Index included – is identified, the existence of the EASEE-gas Common Business Practice (CBP) 2005-001/02 should not be forgotten. In the CBP, a Wobbe-Index value range of 13.60 to 15.81 kWh/m³ is recommended, which gas turbines manufacturers have successfully been using as basis for discussions with their customers and would like to continue doing so.

Other important criteria

Independently from a specific Wobbe-Index range, for which the combustion system may be adapted, it has to be understood, that the Wobbe-Index is only one criterion out of several to evaluate suitability of a fuel gas.

Requirements to meet emission regulations or higher amounts of specific fuel gas components might limit the allowable range of Wobbe-Index for a specific gas turbine. The basic information requested by gas turbine suppliers typically includes the gas composition indicating combustible and non-combustible constituents, for example minimum methane, maximum ethane, maximum other higher hydrocarbons and maximum nitrogen content.

Moving forward

EUTurbines believes that only a flexible approach, allowing regional differences as well as ensuring stable gas qualities is the best way forward.

Ensuring cost competitiveness of gas-fired power plants

The future of gas-fired power plants strongly depends from their economic competitiveness. In that sense, it is, on the one hand, desirable to widen the supply sources of gas and, by this, increase the competitiveness of gas-based power generation.

On the other hand, it must be avoided by all means that an increase in technical requirements due to gas quality variations leads to an increase in costs for the operators of those plants. While the costs will vary depending on the type and size of the installation, hardware adaptations can be in the range of 10%-20% of the cost for a new engine. Adaptations of the plant, additional installations to enhance the gas quality onsite or retrofitting would therefore further decrease the competitiveness of the plants vis-à-vis other generation technologies.

Ensuring the well-functioning of the gas transmission network

Situations that can hamper the performance of gas turbines in the gas network infrastructure need to be avoided. Thus, variations of a pre-defined gas quality are kept to a minimum. Problems in the gas network will additionally affect the delivery into gas consumers – in the case of gas-fired power plants, affecting the electricity security of supply and stability of the grid.

Avoiding the risk of exceeding emissions limits

Gas-fired power plants in Europe need to comply with strict legislative requirements regarding emissions. The most relevant legislation is the Industrial Emissions Directive and the connected Large Combustion Plant (LCP) BREF. The plants are designed with considerable efforts to operate within these strict limits, based on a defined narrow quality bandwidth.

Variations in the gas quality outside a pre-defined bandwidth can, not only affect the performance and efficiency of the gas turbine, but also cause emissions (especially NOx emissions) that exceed the existing legislative requirements, putting the continuation of its permit at risk. Modern premixed burners, with their substantially lower emissions, are in some cases more sensitive to changes in the gas composition compared to traditional burners. It is, therefore, essential that the gas composition that reaches the burner is staying within narrow limits to the values defined in the plant specifications.

Avoiding safety risks due to variations in gas quality

The risk of flashbacks and auto-ignition depends on the composition of the gas. Premixed burners are in some cases sensitive to both, flash-back and auto-ignition. These may lead to serious damages, which in turn also have costs implications.

A flashback occurs when the flame velocity increases and the flow through the combustor cannot balance the change. The risk of auto-ignition is strongly depending from the hydrocarbon species. Two different fuels with the same Wobbe-Index but with different levels of hydrocarbon species will have different auto-ignition behaviours.

A change in the fuel-to-oxygen ratio can lead to flame failures. An increased flame speed and reduced ignition delay times may result from changes in the composition. Both increase the risk of an unwanted flashback.

Using existing good practices

Existing good practices, which are widely applied and have proved to be useful should continue to be applied. This is, for instance, the case of the EASEE-gas Common Business Practice.