Capturing regasification energy to improve turbine performance

07 Jan 2019

Contributed by: Curtis Lovelace, VP Project Development, Stellar Energy

Comments: 0

Natural gas is often referred to as a clean energy source that will serve as a bridging fuel from fossil generation to renewable energy. While natural gas consumption is expected to grow at 1.5%-2% annually through 2040, BNEF projections have LNG consumption increasing at a compounded rate in excess of 4% annually until 2030.

Creating LNG from natural gas is an energy-intensive process; liquefying methane requires more than 800 kilojoules of energy to produce a single kilogram of LNG. Following liquefaction and transportation to the receiving terminal, the LNG must then be vaporised back into its gaseous form in order to be consumed. This vaporisation—or regasification–releases the immense energy required for the initial liquefaction, but now in the form of cold energy. Most often this cold energy is wasted in this regasification process. In many LNG receiving terminals, the cold energy is simply discarded to the surrounding air or seawater, or worse, a fuel-consuming boiler is used to vaporise the LNG. In each of these case,s this free and available cold energy is wasted.

There are two forms of free energy that can be recaptured from the regasification of LNG: thermal and mechanical. The thermal energy from the vaporisation comes from warming of the LNG while the mechanical energy, or work, is a result of the liquid expanding nearly 600 times as it gasifies.

There are many possible uses for the free energy available from LNG regasification, including:

RELATED CONTENT

The growing role LNG will play in the next half-century: Interview with GIIGNL

Interview with Vincent Demoury, General Delegate, GIIGNL – International Group of LNG

Capturing regasification energy to improve turbine performance

Contributed by: Curtis Lovelace, VP Project Development, Stellar Energy

The management of LNG supplies: The Italian case

Contributed by: Rosario Bisbiglia, Director of Short Term Gas Portfolio Management and Logistics, Edison

District Cooling
Cryogenic Air Production
Cold Storage
Power Generation (Rankine Cycle)
Turbine Inlet Air Chilling

Turbine Inlet Air Chilling

Gas turbines experience output lapse as the ambient air temperature rises. This lapse occurs because gas turbines are constant volume machines. As the ambient temperature increases, the density of the air decreases with less air mass flowing through the turbine, thereby reducing the power that can be produced. Turbine Inlet Air Chilling (TIAC), a technology that has been used on hundreds of turbines worldwide, restores the turbine output lapse by cooling the inlet air and increasing the mass flow through the turbine, thus mitigating the power lost due to ambient conditions.

Globally there is nearly 850 MTPA of regasification capacity. For discussion purposes, a 900MW combined cycle power plant in continuous baseload operation will consume approximately one MTPA of LNG. This quantity of LNG, when being regasified for such a combined cycle plant, will release as much as 8000 refrigeration tons (28.1 MW) of free thermal energy which can be used for the cooling of the turbine inlet air.

To put this into perspective, the amount of LNG that is vaporised to satisfy the fuel demands of a given gas turbine will provide enough cold energy to lower the inlet temperature of the gas turbine by approximately 10°C below the ambient dry bulb temperature. This reduction in ambient temperature can increase the output of a gas turbine by 5%-10%. An additional benefit to lowering the inlet temperature is a corresponding 1%-3% improvement in gas turbine efficiency. The capacity and efficiency impacts are primarily a function of the individual gas turbines design.

Often a gas turbine plant that is base loaded may only require the additional turbine capacity in a peak demand situation, typically in the daytime hours. In this situation, a Thermal Energy Storage (TES) water tank can be incorporated into the system to capture the cold energy from regasification of the fuel used in the off-peak periods. This stored cold water can then be used during the peak power demand period, potentially reaching inlet temperature depression of up to 25°C, raising the potential peak turbine capacity improvement to 25%.

One of the hot topics in the industry today is LNG-to-power, where gas turbine power plants are co-located with LNG regasification facilities to bring needed power to locations around the globe. Many of the locations where these projects are being implemented are hot and humid climates that would greatly benefit from the use of TIAC on the gas turbines. As a global leader in the design and delivery of TIAC systems to the power and oil and gas markets, Stellar Energy stands prepared to assist in improving asset performance by recovering lost power.

Keen to share your expert views? Speak at the world's most influential global gas, LNG and energy conference! **Submit your abstract** choosing from a variety of strategic and technical themes to have the chance of speaking at Gastech 2019 in Houston.

Topics: LNG

His Majesty the King of Spain will inaugurate the 30th edition of Gastech in Barcelona

dmg events

dmg events is an international exhibition and conference organiser, publisher and information provider to the Energy, Construction, Plastics, Coatings, Manufacturing, Transport, Design and Hospitality industries.