International Energy Systems in Transition
- Perspectives from Science and Industry -
The 15th IERE General Meeting & German Forum
Abstract Format

Title: Integrating compressed air energy storage into a combined cycle gas turbine plant

James Macnaghten, CEO, Isentropic Ltd
7 Brunel Way, Segensworth East, Fareham, Hampshire, PO15 5TX, UK
Tel +44 1489 565024

Keywords: *CCGT, CAES, ACAES, Thermal Storage, Air Injection, Gas Turbine*

Abstract

This presentation explains how to integrate compressed air energy storage into a combined cycle gas turbine power (CCGT). Normal CCGT's have their power output limited between 40% and 100%. They normally cannot operate below 40% without breaching emissions limits and if shut down they incur a significant maintenance penalty.

In most CCGT's there is significant additional power capacity within the gas turbine that is not normally useable. This extra capacity means that injection of hot compressed air into gas turbines can be used to increase the power output by as much as 20% in a matter of seconds. This 'turn up' can be maintained for periods from a few minutes to 6 or 8 hours. Overall energy production from a CCGT can be increased by around 10%.

Likewise, bleeding hot compressed air from the gas turbine and storing both the heat and high pressure air can allow an operator to 'turn down' their CCGT to around zero (0%) output without switching the gas turbine off. There are very significant maintenance costs associated with shut down and startup of CCGT's. This system allows the owner of the plant to avoid both negative spark spreads and the high maintenance costs associated with frequent start/stops. The storage of heat and high pressure air is achieved by filling and emptying large compressed air and thermal storage tanks.

In both turn down and turn up the ramp rate of the power plant is significantly increased. As the efficiency of the CCGT is improved during 'turn up' the overall change in plant efficiency from operating this system is predicted to be minimal.

This presentation will review an example of a retro-fit to an existing CCGT as well as the potential technical and commercial issues. The technical issues will examine the impact on the gas turbine and the conditions that effect how much air can be safely injected into or bled from the gas turbine. The commercial issues will examine the trade-offs between tank sizes, different market applications and likely payback periods.

In summary: The addition of a compressed air energy storage system doubles the gas turbine operating range by increasing it from the usual 40%-100% to the much larger 0%-120% without shutting the gas turbine down. Overall energy production is increased by 10 % and both negative spark spreads and high maintenance costs associated with frequent start/stops are avoided. The economics of retro-fitting this to existing plant are sufficiently good that it can be deployed with high pressure steel pipe for the compressed air storage, which means that it requires no special geography.

Isentropic is a UK company that has developed a large scale high efficiency method of thermal storage that allows heat to be stored at temperatures of 500 degrees Celsius. This combined with a compressed air storage system and existing gas turbine creates a new storage system called GTI-Storage. Isentropic is backed by the Energy Technologies Institute (ETI), a consortium funded by global engineering companies, oil majors, electric power utilities and British government departments.