# OXY-FUEL COMBUSTION IN A CONVENTIONAL GAS TURBINE BURNER

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There is a growing interest in oxy-combustion for carbon capture and storage (CCS). Emission reduction and lower costs of flue gas cleanup, represent additional benefits of such technology. Recirculated combustion products, consisting mainly of $CO_2$ and $H_2O$, are used for diluting the oxidizer stream and keep low temperature levels. Injection of steam is also an alternative.

The characteristics of oxy-fuel combustion with recycled flue gas differ with air combustion in several aspects primarily related to the higher $CO_2$ levels and system effects due to the recirculated flow. To sustain the flame and attain a similar adiabatic flame temperature, the $O_2$ concentration must be higher, typically 30%, with respect air-combustion (of 21%). Stable combustion and low turbine inlet temperature can be obtained simultaneously by optimizing the ratio of oxygen to $CO_2$ supplies in the oxidizer mixture to the combustion chamber. That requires that about 60% of the flue gas is recycled. Since the exhaust gases contain high proportions of $CO_2$ and $H_2O$, higher gas emissivities are expected. The volume of gases passing through the burner is reduced and the volume of flue gas (after recycling) is reduced by about 80%, while flue gas density is increased.

As oxy-fuel combustion combined with sequestration must provide power to several significant unit operations, such as flue gas compression, that are not required in a conventional plant without sequestration, oxy-fuel combustion/sequestration is less efficient per unit of energy produced.

Aim of the work is to verify the functioning of a conventional gas turbine burner in oxy-fuel operating conditions. The swirled combustor has a thermal power of 300 kW and is provided with a pilot flame and a premixed natural gas fuelled stream.

To this end CFD simulations have been conducted on a tri-dimensional domain consisting of 1 million computational cells. The classical k-ε models and EDC models have been used for turbulence and chemistry respectively.

By varying $O_2$ concentration, e.g. the oxidiser dilution with $CO_2$, and the equivalence ratio, the new operating conditions that ensure flame to sustain have been identified. Oxygen excess helps to reduce CO levels in the flue gas, which are generally higher in $CO_2$ diluted combustion with respect air combustion.

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