Abstract

In power generation with pre-combustion CO₂ capture scheme, hydrogen rich fuel is used in a gas turbine power cycle. The current challenge for the engine is the high reactive combustion properties of hydrogen which makes fuel dilution necessary to achieve low NOx emissions. The Dry Low NOx (DLN) technology developed for natural gas fired gas turbine is based on lean premixing of the fuel with air to avoid the near stoichiometric regions of the flame characterized by high temperatures, hence high NOx formation rate. However, the transfer of this technology to hydrogen has not been successful due to the particularly propensity of hydrogen to flashback at lean mixtures. In the proposed concept high Exhaust Gas Recirculation (EGR) rate is applied to the gas turbine in order to generate an oxygen depleted working fluid entering the combustor. As a result the combustion temperature in this environment is inherently limited, thus keeping NOx formation rate low, without the need for fuel dilution and its consequent efficiency penalty. A first order assessment of the combustion characteristics under such gas turbine operating conditions has been made in *International Journal of Greenhouse Gas Control* Vol. 37:377-383 showing that flame stability could be maintained at EGR rates well above the maximum EGR limit found in conventional natural gas fired gas turbines and that considerable reductions in NOx emissions could be expected. In an ongoing study, we further analyse the concept from a process perspective. The investigation is based on adaptations made to a reference 350 MWel IGCC plant with CO₂ Capture (European best practice guidelines for assessment of CO₂ capture technologies). Results with both dry and wet EGR will be shown as a function EGR rate. Efficiency performance, hence feasibility of the concept and its potential, will be assessed and compared against a conventional pre-combustion power cycle with where the high hydrogen content syngas is diluted with available nitrogen from the Air Separation Unit.