EXPERIMENTAL INVESTIGATION OF LOW-FREQUENCY COMBUSTION INSTABILITY MODES FOR LEAN METHANE–AIR MIXTURES IN LOW-EMISSION COMBUSTORS WITHOUT FLOW SWIRLING

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Abstract: Turbulent homogeneous combustion for lean methane–air mixtures in full-size low-emission combustors designed for industrial gas turbines had been experimentally tested. The investigations showed that for low-emission combustors, being different from the majority of industrial low-emission combustors with their high level of fuel–air mixture homogenization at the burner outlet, increased dimensions of the reverse-flow central zone, and flow swirling nonoccurrence, low-frequency combustion instability modes may arise. Besides, pressure oscillation frequencies originating during combustion instability modes are significantly (by a factor of 3 to 5) less than acoustic eigen frequencies in the combustors under investigation. Amplitude and spectrum of acoustic pressure oscillations depend on the air-to-fuel equivalence ratio in the combustor. To explain the possible mechanisms of combustion instability origination, investigations of turbulent pressure fluctuations without combustion have been performed. The result of the performed investigations is complete damping of combustion instability modes in the investigated low-emission combustors.

Keywords: combustion instability; turbulent homogeneous combustion; low emission combustors

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