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DNS of flame stabilization assisted by auto-ignition at reheat conditions[1] ADITYA KONDURI, Sandia National Laboratories, ANDREA GRUBER, SINTEF Energy Research, JACQUELINE CHEN, Sandia National Laboratories — Staged gas turbines with two sequential combustion chambers are being developed for power generation for their ability to achieve low emissions within a wide operational range while conserving high thermal efficiency. A particular implementation of the sequential combustion concept is characterized by a "reheat" combustion stage downstream of a first premixed-type combustor. Hot exhaust gases from the first stage are mixed with fuel in a mixing section, which provides the inlet conditions for the second-stage reheat combustor. DNS of flame stabilization regimes in the reheat burner, i.e. the combustor including the mixing section (duct-in-a-duct), at idealized conditions is performed using a detailed hydrogen-air mechanism. Results show that combustion occurs in two distinct modes. The first mode is an auto-ignition mode, whereby the vitiated oxidant facilitates the auto-ignition of the fuel in the mixing section. The second mode combines both auto-ignition and flame propagation, with auto-ignition occurring at and around the centerline of the combustor while flame propagation is stabilized at the recirculation zones near the corners. Chemical explosive mode analysis is employed to quantify the contribution of auto-ignition to the combustion rate relative to flame propagation.

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