The current kerosene fuel used in aviation turbines is tightly controlled to a well-defined specification. This fuel specification is a result of the past 50 years of simultaneous research and development between the aviation turbine industry, especially the combustion system, and kerosene jet fuel chemistry.

Recently, there has been a ground swell of interest in alternative fuels for aviation, where the fuels can be made from a variety of feedstocks and processes. The chemistry and composition of species within future alternative fuels will change from the current kerosene jet fuel specifications; therefore research has been carried out looking at the effects of some of the fundamental component species that will be found in potential future fuels. The fuels being researched in this programme have been specifically chosen to look like fuels that could be produced in the gas-to-liquid (GTL) plants currently under construction in Qatar.

Tests were conducted on the Rolls-Royce plc TRL3 sub-atmospheric altitude ignition facility in Derby, UK. The facility was operated at simulated altitude conditions of combustor air inlet pressure and temperature, and fuel inlet conditions to represent combustor conditions following flame-out during high altitude cruise. The gas turbine combustion, ignition and stability characteristics were studied by measurement of the successful ignition and flame stability using a series of GTL SPK-type fuels. The combustor under test was a multi-sector representation of an advanced gas turbine combustor and fuel injector.

The GTL SPK-type fuels were selected to generate a pseudo-design of experiments (DoE) matrix in which the iso- to normal-paraffin ratio, cyclic paraffin content and carbon number range were varied in order to isolate the effects of each. Tests were conducted at combinations of air mass flow rate and fuel-air ratio necessary to map the regimes of successful ignition and flame stability.

Results for all the fuels tested showed no deterioration to the weak boundary of the ignition regime, or the weak extinction limits within the scatter of the experimental method. Evidence was found that 100% GTL SPK from Shell’s production facility in Bintulu, Malaysia, as well as one of the DoE blends, have greater ignition performance at simulated altitude conditions.