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Low Emissions Fuel Flexible Combustor Technology

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Summary

The fuel-flexible, low-NOx (Nitrogen oxides) combustor task of the Environmentally Resonsible Aviation (ERA) project is to develop a low emissions combustor capable of meeting the Landing and Take-Off (LTO) NOx emissions reduction while reducing aircraft fuel burn by 50% without negatively impacting other emissions and achieving perceived noise levels 42 dB below stage 4 limits. The low emissions combustor should be capable of meeting the mid-term LTO NOx goal of 75% reduction from the International Civil Aviation Organization (ICAO) standard adopted at Committee on Aviation Environment Protection (CAEP 6). In addition to NOx and Other emissions performance, the combustor must continue to meet the standard requirements for an aircraft gas turbine combustor. These requirements include flame stability over all operating conditions, robust relight at flight altitudes, efficiency of greater than 99.9 percent, minimal pressure losses, full life for combustor components, as well as length, weight, and cost that meet system level goals. How each concept will meet these criteria is a significant weighting factor in any combustor selection process. ERA combustor task investigates both lean and rich concepts such as GE's TAPS combustor and P&W's TALON X combustor respectively. In parallel to GE and P&W contracts, NASA Glenn Research Center also conducts in-house research in the following three areas: 1) design and screen concepts for fuel injector and demonstrate the capability to meet 75% NOx reduction in flametube and sector rigs; 2) Ceramic Matrix Composite (CMC) liner materials; and 3) active combustion control for combustion dynamics.

Fuel flexibility of the combustors will also be investigated. Testing by NASA and others conducted so far suggests that synthetic fuels help to mitigate particulate and smoke emissions (Ref. 1). An evaluation of the fuel properties by Boeing and NASA researchers (Ref. 2) also indicate that these fuels do not pose serious issues.

References

1. 1. ICAO Engine Database

2. Carl Burleson, "Commercial Aviation Alternative Fuel Initiative (CAAFI): An Overview"

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