Laser Diagnostic Measurements in the Laboratory-Scale Gas Turbine Combustor

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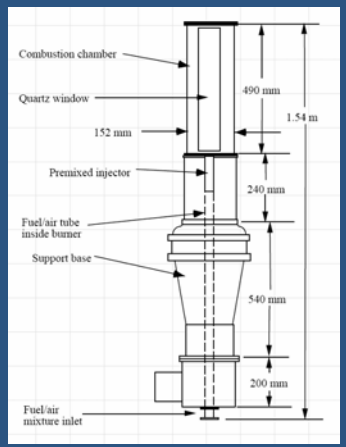
Introduction

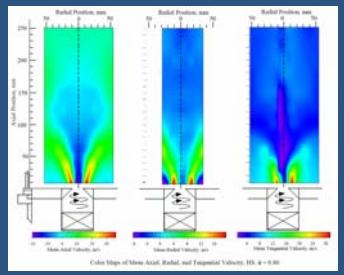
- Data were taken in a combustor using advanced laser diagnostics.
- Combustor operated at four conditions: two lean equivalence ratios (Φ=0.65, 0.80) and two swirls (SN=0.74, 1.29).
- Data include velocities (axial, radial, tangential), temperatures, and OH species concentrations.
- Data was taken using Laser Doppler Anemometry (LDA) for velocity, Coherent Anti-Stokes Raman Spectroscopy (CARS) for temperature, and Planar Laser-Induced Fluorescence (PLIF for) OH concentration.

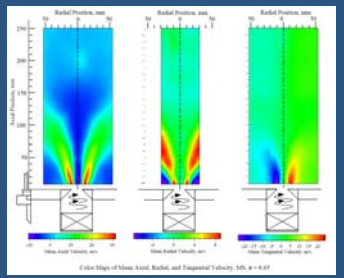
Combustor Facility



LDA Velocity Data

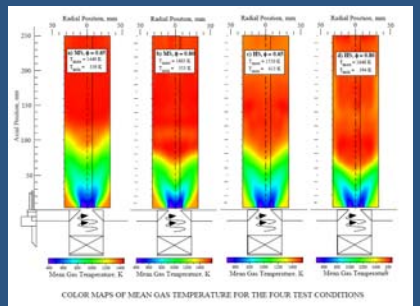
- Laser Doppler Anemometry (LDA) was used to measure velocities.
- Axial, radial, and tangential velocities were measured.
- Velocity data show the existence of both a central recirculation zone (CRZ) and a side recirculation zone (SRZ).
- These data also show that increasing the swirl increases peak radial and tangential velocities.





CARS Temperature Data

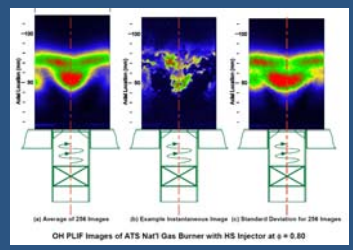
- Coherent Anti-Stokes Raman Spectroscopy (CARS) was used to measure temperatures.
- Temperature data show that both the CRZ and SRZ are effective.
- Temperature data show that increased swirl shortens the flame.
- The temperature data also show that increasing the equivalence ratio shortens the flame and increases the peak temperature.
- Temperature data show that the SRZ is more effective for the lower swirl condition.



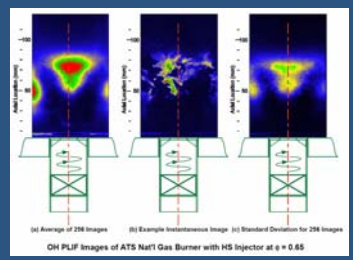
COLOR MAPS OF MEAN GAS TEMPERATURE FOR THE FOUR TEST CONDITIONS

PLIF OH Concentration Data

- Planar Laser-Induced Fluorescence (PLIF) was used to measure relative OH concentrations.
- These relative measurements have not been correlated to actual OH concentrations.
- The instantaneous OH concentration data show the turbulent nature of the flame front.
- The average OH concentrations show that changing the swirl alters the shape of the flame front.
- These data also show that increasing the equivalence ratio decreases the flame length.



OH PLIF Images of ATS Nat'l Gas Burner with HS Injector at ϕ = 0.80



OH PLIF Images of ATS Nat'l Gas Burner with HS Injector at ϕ = 0.65

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