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Prebreakdown Luminosity Increase In Flames JACKSON PLEIS, ROBERT GEIGER, DONALD KENDRICK, ClearSign Combustion Corp., ADVANCED RESEARCH IN COMBUSTION TEAM — When an external electric field is applied to the combustion zone electron-neutral collisions can lead to vibrational excitation and ionization at higher electric field strengths. Prebreakdown electric fields are observed to affect the luminosity of the flame. This is accompanied by changes in combustion efficiency, pollutant production, and heat transfer. Luminosity increases rapidly (˜10 ms) and is voluminous. Pulsed voltages shorter than 5 ms do not affect the luminosity. These timescales suggest that an increase in soot production is not the cause. Furthermore, electron impact reactions are also not a likely culprit. An ionic mechanism seems most plausible. At a critical applied voltage, transient breakdown occurs within the flame. Plasma discharges were observed using a high-speed camera. Discharges can occur between hot spots within the flame. These breakdowns occur randomly, due to the turbulent nature of the flame. Certain conditions lead to CO decreases with increases in the corrected NOx (cNOx) while other conditions can produce the opposite result. When breakdown occurs, cNOx increases with little effect on CO. A prebreakdown optimum is observed for minimizing the CO and cNOx emissions. The dominant mechanism is expected to be enhanced mixing due to ion wind effects.

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