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Burner Condition Monitoring based on Flame Imaging and Data Fusion Techniques

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Rapid growth in electricity generation from intermittent renewables has resulted in increasing demand in conventional fossil-fuel power stations for plant flexibility, load balancing and fuel flexibility. This has led to new challenges in plant monitoring and control, particularly securing combustion stability for optimizing combustion process in terms of furnace safety, fuel efficiency and pollutant emissions. An unstable combustion process can cause many problems including furnace vibration, non-uniform thermal distribution in the furnace, high pollutant emissions and unburnt carbon in the flue gas. The stability of burners should therefore be continuously monitored and maintained for the improved overall performance of the furnace. A study is carried out to investigate the burner stability based on flame imaging and data fusion techniques. Experiments were carried out on a 915 MW_{th} coal-fired power station. A bespoke flame imaging system (Fig. 1) was employed to acquire flame images from 16 individual burners (4 mills each with 4 burners) with a frame rate up to 200 frames per second. The characteristic parameters of the flame, including temperature, non-uniformity, entropy, oscillation frequency and colour characteristics (hue, saturation and intensity), are computed. The relationship between the flame characteristics and burner inputs and flue gas emissions (e.g., NO_x) is quantified. Stability index is then introduced as an indicator of the stability of individual burner. Fig. 2 illustrates typical flame images for different burners. Detailed test results and analysis will be presented at the conference.

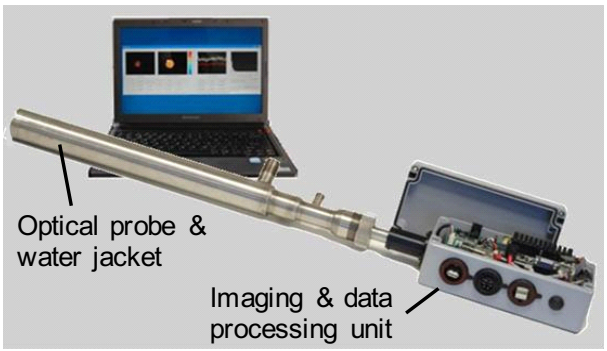

Fig. 1 Overview of the flame imaging system

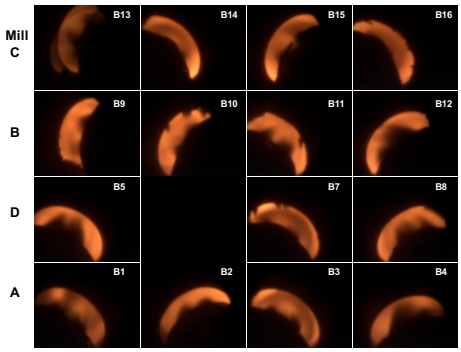

Fig. 2 Flame images of 16 burners

Keywords: coal-fired boiler, flame, burner condition, combustion stability, digital imaging, image processing.

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