Graduate Student Research Seminar

Fall 2021

Full Scale 3d Computational Model of the Industrial-Scale Coal Fired boiler Performance for Temperature Sensor Installation Guidance

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3:00 pm (EST) – 132 Fluor Daniel Building

Abstract

Nearly 30% of the electricity is generated by using coal as the primary fuel in US. One of the major concerns in coal fired powerplant is the failure of boiler tubes that leads to unscheduled maintenance and has huge economical and society impact. High temperature flue gas along with ash pass over the boiler tubes which overtime leads to tube failure. Therefore, developing temperature sensor for harsh environment and install them for temperature sensing and boiler tube lifetime prediction is an urge need. On the side of sensor development, the location of the sensor installation is important for stable sensing performance and easy calibration. In this study, computational fluid dynamics and heat transfer modeling are adopted to establish a full-scale 3-dimensionalmodel of a coal fired boiler to investigate the flue gas temperature distribution within the boiler and identify the proper locations for sensor installation. We proposed three criteria to select the temperature sensor installation location:(1) select the boiler tube panel away from the side walls, (2) select the boiler tube section closer to the top wall of the boiler; and (3) select the boiler tube on the back of the boiler panel (not directly facing the flue gas flow). In these regions, the flue gas temperature is stable, providing an ideal environment for stable temperature sensing and calibration. This work will bring an in-depth understanding of the steam pipe failure mechanism and the relation between potential failure and the operation conditions. This work can be adopted to guide the future operation of the coal plants to reduce the number of unexpected incidents and power plant outages.

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