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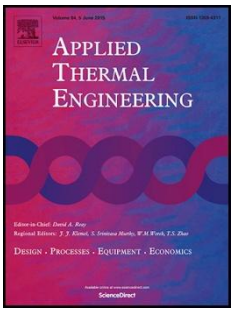

Title: Modeling and analysis of flow instability of the water wall in a 600 MW supercritical w-shaped boiler

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PII: S1359-4311(16)00040-5
DOI: http://dx.doi.org/doi: 10.1016/j.applthermaleng.2015.12.144
Reference: ATE 7563

To appear in: *Applied Thermal Engineering*

Received date: 23-4-2015
Accepted date: 31-12-2015

Please cite this article as: Yanrong Shen, Dong Yang, Zhi Shen, Beibei Xie, Long Wang, Modeling and analysis of flow instability of the water wall in a 600 MW supercritical w-shaped boiler, *Applied Thermal Engineering* (2016), http://dx.doi.org/doi: 10.1016/j.applthermaleng.2015.12.144.

Modeling and analysis of flow instability of the water wall in a 600 MW supercritical W-shaped boiler

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Highlights

- A general model is established to enlarge the study on flow instability of supercritical boiler.
- Non-uniform heat flux distribution and various geometric structures and tube types are considered in the model.
- The model is proved to be reasonable to study flow instability of supercritical boiler.
- The stability of a 600 MW supercritical W-shaped boiler is numerically analyzed.

Abstract: In order to further expand the study on flow instability of supercritical boiler, a general model was developed applying time-domain method. To improve the generality of this model, non-uniform heat flux distribution and a variety of geometric structures and tube types were considered. Calculation results were compared with numerical and experimental result respectively. According to the comparisons, the model is proved to be reasonable and accurate for practical engineering application. Based on the validated model, flow instability of the water wall in a 600 MW supercritical W-shaped boiler at subcritical and supercritical pressures was numerically analyzed. Pressure drop versus mass flow rate characteristic curves were obtained. Effects of parameters, including inlet pressure, inlet mass flow rate, inlet and outlet pressure drop coefficient, on dynamic instability were analyzed. Results show that no Ledinegg instability occurs at the operating conditions. Parametric effects on dynamic instability at supercritical pressure behave the same compared to that at subcritical pressure. With an increase of inlet mass flow rate and inlet pressure, stability of the boiler is enhanced. With decreasing inlet pressure drop coefficient and increasing outlet pressure drop coefficient, stability of the boiler is reduced.

Keywords: W-shaped boiler; flow instability; modeling; time-domain method

1. Introduction

Flow instability has caused wide concern on the design and operation of various heat transfer equipments, such as nuclear reactors, refrigeration plants and boilers. It may result in oscillation of wall temperature, fatigue damage of tube and heat transfer deterioration [1]. So investigations on flow