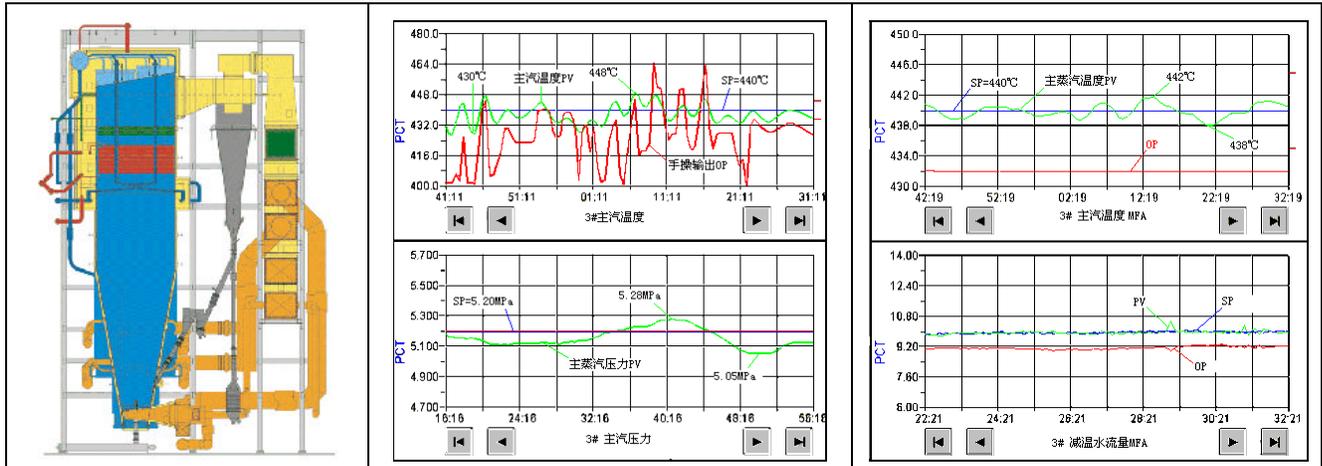


# Model-Free Adaptive Control on Fluidized-Bed Boilers

| <i>Use of MFA Control</i>   | <i>Benefits</i>  |
|---|--|
| Nonlinear MFA tightly controls master steam pressure.                                     | Pressure control is improved for a smoother turbine generator operation.   |
| Anti-Delay MFA tightly controls steam temperature.  | Temperature control is improved by at least a 50% reduction in temperature variability for higher combustion efficiency, reduced emission, and lower fuel usage. |
| Feedback and Feedforward MFA controls steam drum level under large pressure load changes. | Boiler and steam system stability is improved and meets flexible production needs for power and steam co-generation.   |



The picture at left shows a fluidized bed steam generator by Babcock Borsig Power. The middle and right pictures show the difference in the steam temperature and pressure under manual (L) and MFA control (R).

## Case History: MFA at Jiang-Yuan Energy and Power Cogeneration Plant

Fluidized-bed boilers are becoming a strategic operating unit in power and energy generation. The unique design allows fuel such as coal powders to be fluidized in the air so that they have better contact with the surrounding air for better combustion. Fluidized-bed boilers can burn low-grade fuel such as waste coal, wood, and refuse derived fuel, etc. Most importantly, less emissions such as COx and NOx are produced compared to conventional boilers.

The Chinese government has issued a new regulation forcing the shut down of all small power plants (200MW or less) unless the boilers are changed to fluidized-bed boilers. The purpose is to achieve

economical benefits and reduce air pollution at the same time.

A fluidized-bed boiler typically consists of several key process variables: steam pressure, temperature, coal feed rate, air supply, steam drum level, etc.

Control difficulties result from large time delays and lags in the temperature loop, nonlinear nature of the pressure loop, large load changes, and the shrink-and-swell problem in the steam drum level. Particularly, low-grade fuel has an inconsistent Btu value causing good fuel-air-ratio control to be very difficult.

According to Mr. Long-Bao Wu, chief engineer at Jiang-Yuan Co-gen Plant, a

CyboCon CE control instrument and a CyboCon software package have been installed to control two 75 Ton/Hour fluidized-bed boilers. MFA controllers are able to control steam temperature, steam pressure, and steam drum level effectively. "These loops are usually in manual control. We are very impressed with the capability of MFA control and have certified a document for the CyboSoft Shanghai company claiming our successful installation." Mr. Wu commented.

Good control performance has been achieved with these results:

- Steam temperature variation  $\pm 2^{\circ}\text{C}$ ,
- Steam pressure variation  $\pm 0.1\text{Mpa}$ .