

Study of Dynamic Responses of Coal Fired Power Generation Process using Intelligent Systems Techniques

Professors Evor Hines and Jihong Wang

Background:

By 2015, 20GW and by 2030, 48 GW generation capacity in the UK (accounting for 60% of total present generation capacity) needs to be replaced as the UK energy infrastructure is ageing fast. To achieve the government goals for reducing carbon emissions by 20% by 2020 and 80% by 2050, while ensuring the energy system remains reliable and affordable is vital to long term economic competitiveness. Apart from renewable energy, coal-fired power generation will continuously play an important role.

Due to high emissions in CO₂, the public often perceive coal as an unclean energy source and thus unacceptable. Therefore, cleaner coal technology must be adopted for any new coal-fired power stations. Supercritical boilers provide lower CO₂ emissions through improved energy efficiency. In fact, power plants using supercritical generating units have energy efficiency up to 46%. This is around 10% more than conventional power plants. However, power plants adopting supercritical boilers face great challenges from the UK National Grid Code (NGC) compliance. It is uncertain if power stations using supercritical boiler units can achieve NGC required ten seconds recovering time while 10% frequency deviation occurs.

Objectives:

Although there are currently no supercritical boilers in operation in the UK, there are more than 240 supercritical units worldwide. The project aims to conduct modelling studies of supercritical boiler dynamics using Intelligent Systems techniques. This will be the first step towards to modelling the complex whole power plant process for Grid Code Compliance study.

Methods and tasks:

Data: Multi-sets of data have been collected from a 1000MW power plant supercritical boiler, which is available to be used for this project.

Method: The project will explore the extent to which Intelligent Systems techniques (Artificial Neural Networks, Fuzzy Logic, Evolutionary Algorithms and hybrid combinations such as neuro-fuzzy systems, neuro-genetic systems etc) may be applied to develop novel and effective solutions to the challenges inherent in this projects.

Tasks:

- 1) To study power plant process to gain the background knowledge required;
- 2) To study the Intelligent Systems techniques;
- 3) To conduct data analysis and to group the data set into groups of training testing and validation sets;
- 4) To develop a number of potential solutions for modelling the supercritical boiler dynamic responses and evaluate their suitability.

Potential for a PhD project: It is possible to extend the methods to modelling and optimisation of the whole of complex power generation system. This can proceed in parallel with an on-going EPSRC research project in supercritical power plant modelling and simulation study.