Combined Cycle Gas Turbines (CCGT) Service

Background

There are two types of gas-fired power plant – Combined Cycle and Open Cycle Gas Turbines – otherwise known as CCGT and OCGT. The OCGT operates by using gas mixed with air to fuel a gas turbine, which then spins a generator to make electricity. The CCGT does the same, but in addition uses the heat from the turbine exhaust to heat a boiler, the steam from which powers a steam turbine and second generator (twice the electricity for the same fuel costs).

In the case of the CCGT / OCGT plant, the amount of power produced by the turbine is highly dependent on the weather. The amount of fuel that can be efficiently burnt is determined by the temperature, pressure, and humidity of the air with which it is mixed. Normally, the colder it is, the more efficient the plant is.

However, local air temperature around the site can vary by as much as 5 degrees from place to place, so the ambient air temperature is not accurate enough a measure to predict the efficiency of the turbines.

The solution

Since 2004 the Met Office has provided RWE npower with a service based on the use of site-specific forecasts coupled with Kalman filtering to give hourly temperature forecasts, not just for the site of the power station as a whole, but specifically for the air in-take filters for each of the gas turbines.

In order to do this, a thermometer must be placed at each of the air in-take filters, and hourly readings fed back to the Kalman filter. The Kalman filter is able to learn by comparing actual temperature readings with model forecasts from the Met Office's site specific model. The more time goes on, the more accurate its predictions become.

Benefits

This increased accuracy of temperature forecasting brings great benefits to the customer. It has been estimated that every increase in accuracy of temperature predictions of just 1 degree Celsius translates as an increase in the power plant's revenue of 3.45MW.

This is equivalent to around £1,500 per day. More importantly, perhaps, the increased accuracy allows the customer to make decisions based on these forecasts with greater confidence. This product can be adapted to any location and will be beneficial in any sector where site-specific forecasts are of value.

Firm/Consultant's experience

Project/assignment name:
CCGT Enhanced Service

Project country: UK	**Duration of assignment:** 25 months
Name of client: RWE npower	**Total number of staff-months on the assignment:** 2 man-months (development)
Project address: Trigonos, Windmill Hill Business Park, Whitehill Way, Swindon, Wiltshire, SN5 6PB	
Start date (month/year): **Completion date (month/year):** January 2005 – February 2008	**Number of professional staff-months provided by associated consultants:** N/A
Name of associated consultants, if any: N/A	**Name of senior professional staff of your firm involved and functions performed (indicate most significant profiles such as Project Director/Coordinator, Team Leader):** Clare Bysouth – Senior Applied Scientist

Narrative description of project:
The CCGT service is based on the use of latest site-specific modelling together with Met Office post-processing techniques to give temperature forecasts for the air in-take filter of each turbine, rather than just an ambient temperature.

Description of actual services provided by your staff within the assignment:
The enhanced service provided by the Met Office is based on the use of site-specific forecasting coupled with Kalman filtering to give temperature forecasts for the air in-take filter for each turbine rather than just an ambient temperature. A thermometer is placed at each of the air in-take filters and feeds back hourly readings to the Kalman filter, which compares actual temperature readings with model forecasts from the Met Office site-specific model. The project investigated the correlation between increased accuracy and time.

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