Digital Twin Technology for Boiler Operation

By Tata Consultancy Services | Category: Implemented Innovations

TCS has developed a digital twin technology for coal-fired boilers in thermal power plants. The digital twin combines artificial intelligence with physics and domain knowledge and can be deployed on premise or on cloud. This technology has helped in shortening of boiler commissioning time and in reducing NOx emissions.

The Context

Combustion tuning of a boiler is carried out to determine the optimum settings for a given coal to ensure safe, economical and environmentally friendly operation.

Manual tests are conducted over a period of 7-10 days incurring plant operating costs and loss of revenue. Expert knowledge is used to design the tests, with minimal exploration of input parameter space, and a limited number of tests.

Optimal settings are identified by the expert based on his/her skill and experience. However, finding the optimum settings in a multi-input and multi-output system involving large number of parameters is challenging for the human mind.

Major change in coal type (~1 year) and in plant condition (~2 years) also require combustion tuning.

The Innovation

Combustion Tuning of boilers is typically carried out by specialists who conduct multiple tests on the plant during the commissioning phase. The expertise and combustion tests come at a massive cost for the utility company (2M USD per day).

This innovation focuses on building a digital twin of the boiler that consists of:

Artificial Intelligence (AI) Model to predict process parameters using real-time data from 2000+ sensors from the plant

Enhancing the prediction combined with boiler operations domain knowledge and physics of the phenomena involved

The innovation was able to deliver a number of benefits:

Reduction in the number of tests conducted in the plant

Better optimum conditions and multiple modes of optimisation such as reduced emissions and safe operating conditions

Overcoming Challenges

Challenge #1

Availability of actual data: access for implementation in power plant

Challenge #2

Combining physics, data science and domain knowledge: TCS proved the technology on sample data and convinced the customer about the benefits of digital twin technology. This has helped in getting access to data and power plant for implementation. TCS involved cross functional teams from CTO, EIS-IOT and TCS Japan to develop, deploy and demonstrate its results at a power plant in Taiwan.

Impact of the Innovation

revenue impact

$10 mn

TCS is working towards building an application that can ensure continuous economical operation of coal-fired power plants by enhancing the performance of the power plant while maintaining safe operating conditions and reduced environmental pollution (despite using coals from different sources with widely varying properties).