

# Development of Power Plant Performance Degradation Diagnosis Technique based on Heat and Mass Balance Analysis

## Background

It is necessary to maintain or improve the thermal efficiency and decrease the cost in the power plant. For that, it is necessary to investigate the performance degradation factors and to perform measurements promptly. However, it is difficult to adequately understand the internal state of the plant and to specify the performance degradation factors only by the measurement data. Moreover, to evaluate the performance of the plant, it should be converted to standard state so that it may receive the influences of atmospheric conditions (temperature, pressure, and humidity) and the temperature of sea.

## Objectives

To develop the software to calculate the immeasurable quantity of state and efficiency of equipment and convert the performance of the plant to standard state by using measured data in power plant, and simulate the performance of the plant when changing the operating conditions. And to investigate the performance degradation factors in power plants by this software.

## Principal Results

### 1. Development of the software to support maintenance and operation in power plant

To develop the software to support the effective maintenance and operation in power plant, the kernel of the software was "EgWin" developed by our laboratory to analyze heat mass balance of various power generation systems. The main features are as follows.

- (1) It can calculate the immeasurable quantity of state and efficiency of equipment by heat mass balance analysis, and process a large amount of data in the plant computer by automatic data reading function and continuous calculation function.
- (2) The data retrieval and inspection can be facilitated by the database function. And the secular degradation of equipment performance and the correlations of atmospheric conditions and the equipment performance, etc. can be understood by graphing. (Fig.1)
- (3) It can simplify the labor of the thermal efficiency management online and by the automatic analysis function; the data of the plant computer is saved to data file every cycle, the data file is read and the heat mass balance is calculated automatically. (Fig.2)

### 2. Investigation of performance degradation factors in power plants

- (1) The performance function of the GT compressor to atmospheric conditions was made from the accumulated analytical data. As the compressor efficiency converted to standard atmospheric conditions by this performance function, we could compare the compressor efficiency in commencement of commercial operation with the present efficiency under the same condition and clarify true amount of the performance decrease of the compressor. (Fig.3)
- (2) By converting to standard state about other equipment efficiency also, the influence that those individual factors gave thermal efficiency was quantitatively calculated, and the key factor of the thermal efficiency decrease was specified. (Fig.4)

## Future Developments

The number of power plants where diagnosis of performance degradation and simulation of operating condition changes by this tool have been carried out has reached more than 20, and these efforts have contributed to improving thermal efficiency. In future, with a view to further enhancing operation control of power plants, we will strengthen the function of this tool and develop more detailed techniques for analyzing the thermal efficiency decrease factor.

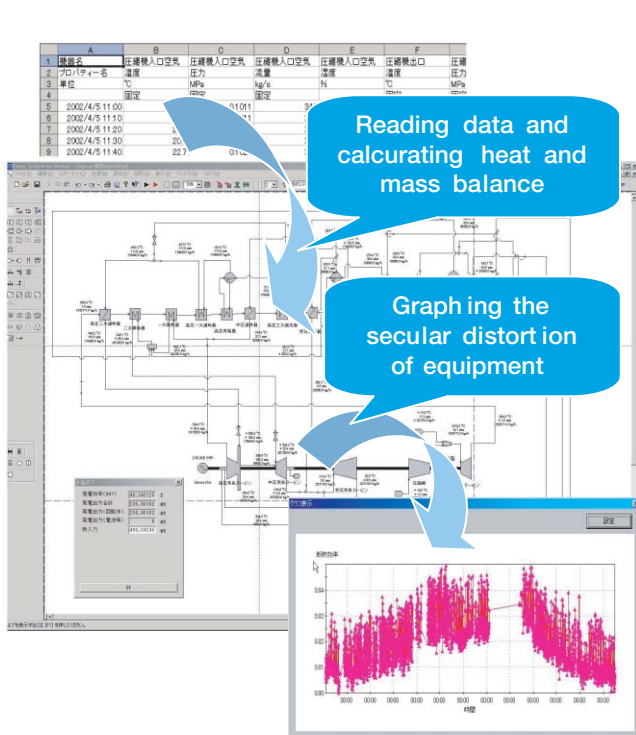
**Main Researcher:** Toru Takahashi,

Research Scientist, Plant Engineering Sector, Energy Engineering Research Laboratory

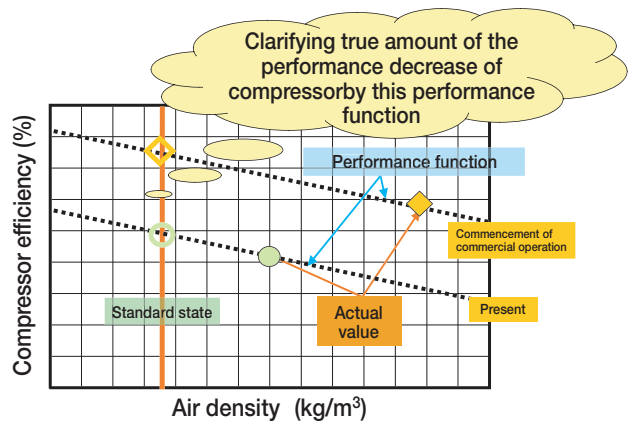
## References

- T. Takahashi, et.al, 2007, "Analysis and evaluation about Advanced humid air turbine system," International Conference on Power Engineering-2007
- E. Koda, et.al, 2007, "Use of thermal efficiency analysis program for power generation systems (EgWin) to existing power plant," The Thermal and Nuclear Power Generation Convention 2007 (in Japanese)

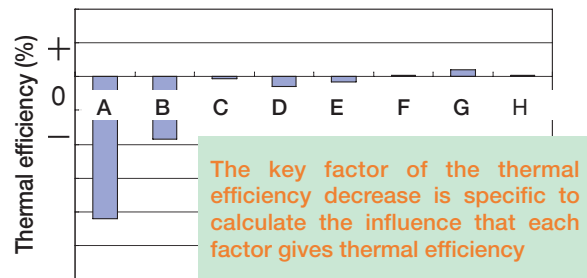
## 6. Fossil Fuel Power Generation - Advanced maintenance technology



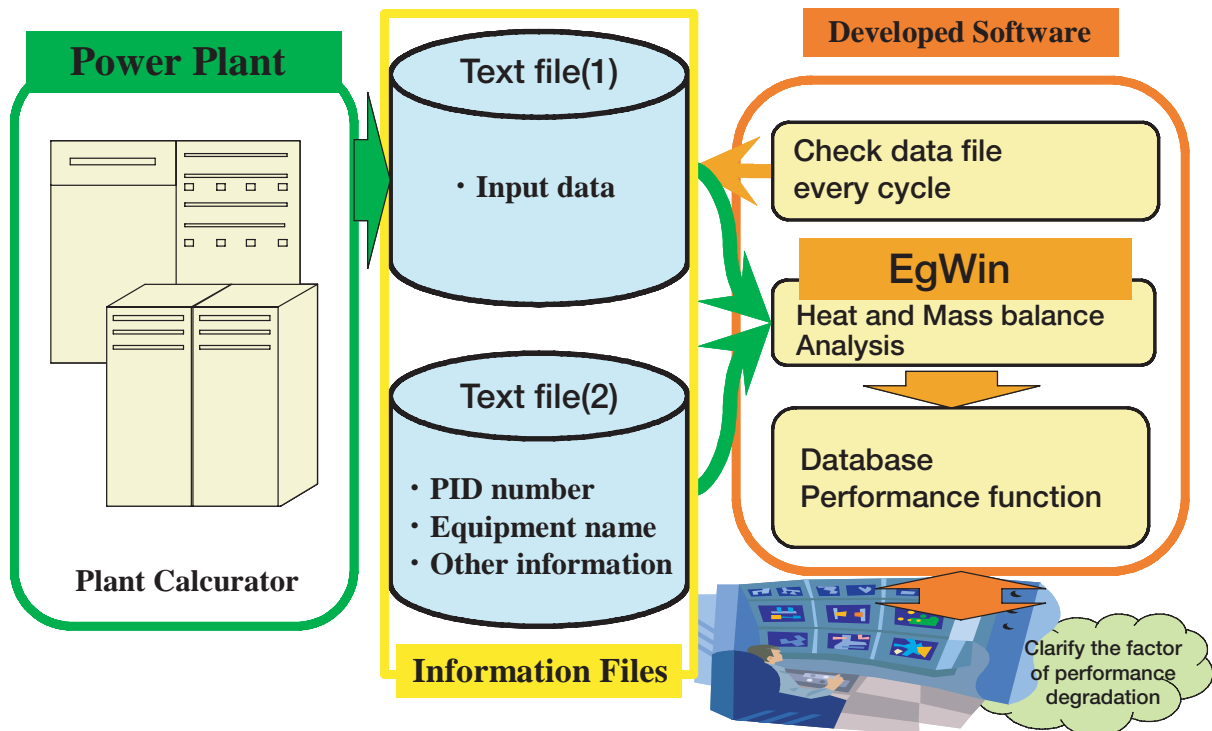
**Fig.1** Continuous calculation and graph by data base



**Fig.3** Evaluation of equipment performance converted into standard state



**Fig.4** Influence that each factor gives thermal efficiency



**Fig.2** Online and auto analysis function