User-friendly Advanced Software Tools Developed for Computer Control System Supplied to TOKYO ELECTRIC POWER COMPANY

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OVERVIEW: To meet the requirements for an open architecture computer system for TEPCO's thermal power station that will reduce their equipment investment, we collaborated with TEPSYS of the TEPCO Group and successfully completed the computer control system replacement project of the Unit No. 6 of KASHIMA THERMAL POWER STATION. To ensure the collaboration moved forward smoothly, Hitachi developed a set of sophisticated and user-friendly tools and provided the tools to TEPSYS. In this project, TEPSYS used the tools to create special application data, and Hitachi provided general-purpose hardware and power station middleware. With deep mutual understanding, two partners combined their products, and successfully replaced the computer control system.

INTRODUCTION

RECENTLY, the electric power industry has been reducing its investment in equipment, including that for supervisory computer control systems. Generally, such systems for thermal power stations are manufactured according to each power station's specific requirements, and while this provides the best solutions for each power station, designing and manufacturing the special functions always raise the production costs. In addition to the special software functions, custom-made hardware required by each power station is another reason for high production costs. With the expansion of PC (personal computer) capabilities and user knowledge, however, creating power station data is no longer a difficult task that can only be performed by a vendor's engineers. The client's engineers, who understand the power station operation well, can also create the data (see Fig. 1).

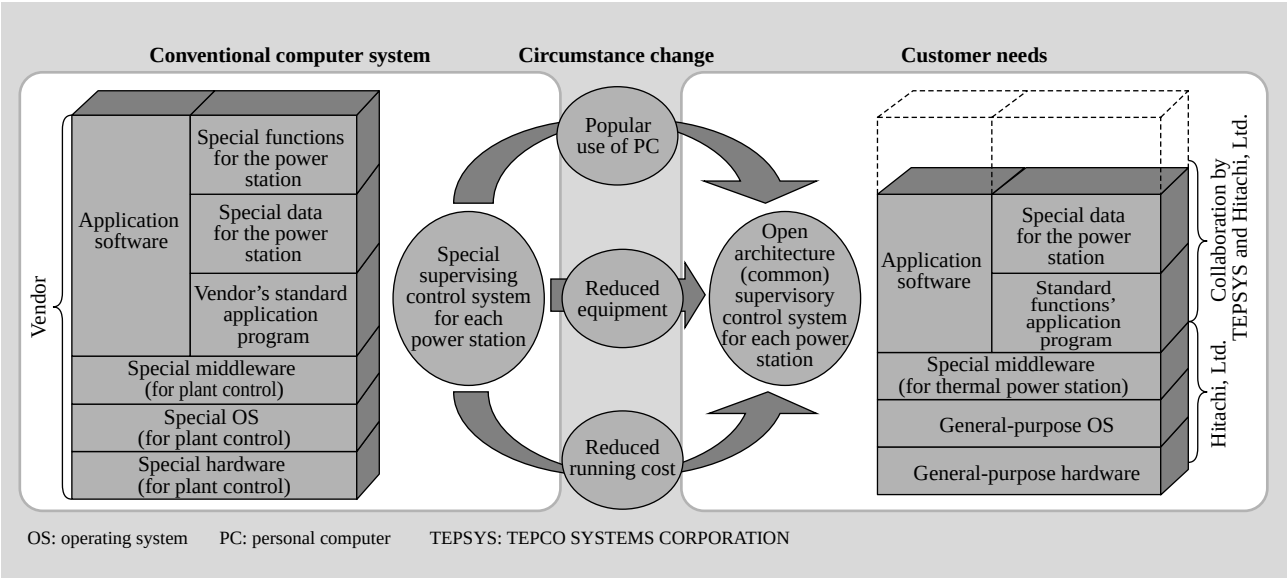


Fig. 1—Work Assignment of "Open Architecture Computer System for Thermal Power Station" Supplied to TOKYO ELECTRIC POWER COMPANY (TEPCO).
To get the order of a computer supervisory control system for thermal power station, the vendor is required to collaborate with the client's affiliated company.

Under these circumstances, TOKYO ELECTRIC POWER COMPANY (TEPCO) decided to use general-purpose hardware for its computer system, and to standardize the software specifications. TEPCO eliminated differences in function specifications between power stations and vendors by using general-purpose hardware, and assigned the task of developing application functions to its associated company TEPCO SYSTEMS CORPORATION (TEPSYS).

In the project to replace the computer system at the Unit No. 6 of KASHIMA THERMAL POWER STATION, Hitachi provided the hardware as well as the OS (operating system) and middleware of the client and server system. Hitachi also provided an application program of standard functions for the application software and user-friendly advanced software tools for TEPSYS to create special data for the power station.

This paper describes the work assignments in the Unit No. 6 of KASHIMA THERMAL POWER STATION project, the user-friendly advanced software tools that made it possible to collaborate with TEPSYS and our prospects for the future.

OUTLINE AND FEATURES OF THE REPLACEMENT OF SUPERVISORY COMPUTER CONTROL SYSTEM

The computer system before replacement was a stand-alone computer that contained all supervisory and control functions. The special functions and data were all created by Hitachi under the direction of clients.

In this project, Hitachi not only provided all the functions using its state-of-the-art technologies, but also replaced the system with general-purpose computers in line with the new TEPCO policy described above.

The main features of the open architecture computer system (see Fig. 2) are as follows.

(1) The existing computer system was replaced by an autonomously distributed client-server system. The client and server computers are PCs for industry use with an 8-year guarantee (HDP-C, S: Hitachi distributed processor-client, server), and the OSs are general-purpose Windows*1 XP and Linux*2. The general-purpose network is connected by 100-M Ethernet*3 hubs, and the process input/output devices are Hitachi special devices with a 15-year guarantee.

(2) All the computers in the system are connected by a network, including three (except for the engineering work station) operator stations with human-machine interfaces, two control servers with automatic plant

*1 Windows is a registered trademark of Microsoft Corporation in the U.S. and/or other countries.
*2 Linux is a registered trademark of Linus Torvalds in the U.S. and other countries.
*3 Ethernet is a registered trademark of Xerox Corporation.

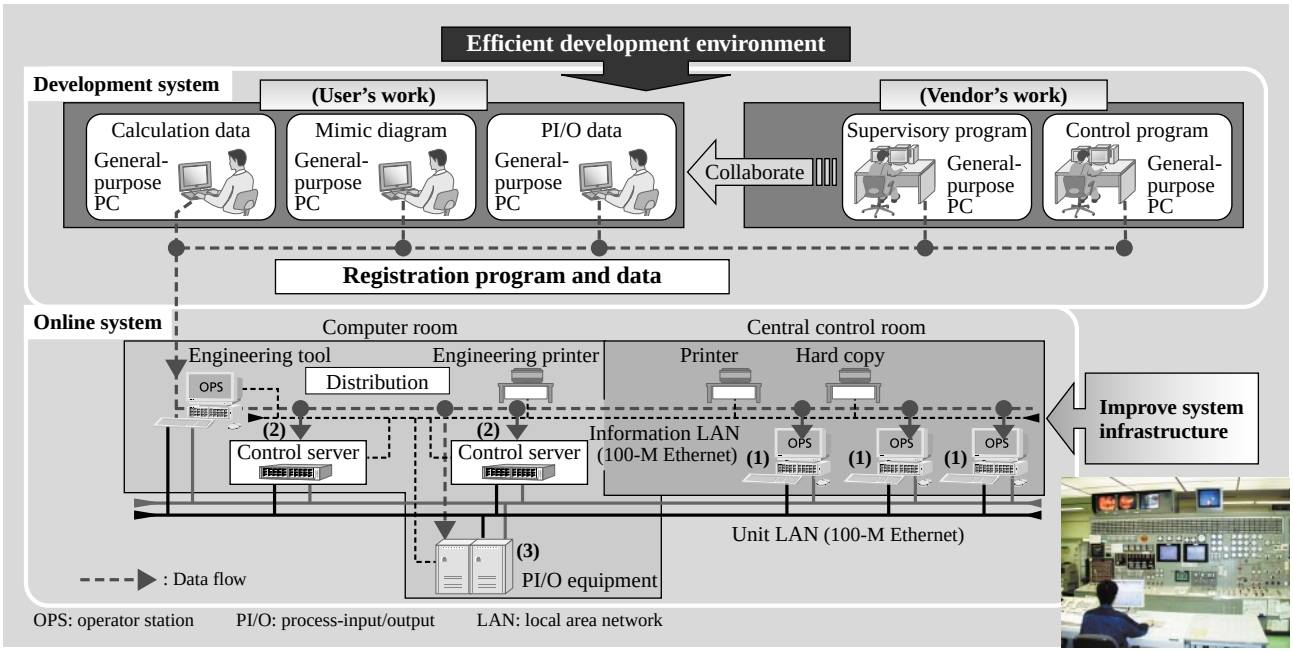


Fig. 2—Approach Used to Build Open Architecture Computer System and Central Control Room.
The system provides a development environment to the user, so the user can create specialized data for the power station.

start-up and shutdown control, performance calculation, and logging functions, and two process input/output devices for creating engineering values and output functions.
(3) The sophisticated system was developed by Hitachi based on the standard application software function specifications designed by TEPCO that removed differences in function specifications between power stations and vendors.
(4) The special data for the power station was designed and created by TEPSYS including calculation data (e.g. for performance calculations), mimic diagram data, and process input/output data. The standard software programs that supervise and control the power station were designed and created by Hitachi.

In order to collaborate with a client's affiliated company to replace the plant-control computer system, it was necessary to provide a complete and efficient development environment, and to improve the system infrastructure. To create the necessary development environment, Hitachi provided a user-friendly and intuitive application data creation tool, and a set of user manuals. To improve the system infrastructure, Hitachi provided a test tool that can run on the general-purpose PC used for creating data, as well as tools to transfer and register the created data to an online system.

DEVELOPMENT OF THE APPLICATION DATA CREATION TOOL

Compared with working individually, collaborating with others might cause some problems at the interface part of the project. To ensure the collaboration move forward smoothly, Hitachi provided the following tools for TEPSYS to use in creating the special application data.
(1) Calculation data creation tool
(2) Mimic diagram creation tool
(3) Process input/output data creation tool

Calculation Data Creation Tool

In a conventional system, the calculation data is created in the following steps:
(1) Make calculation specifications and characteristic curves document
(2) Develop programs and create data according to the documents
(3) Transfer the programs and data to plant-control computers
(4) Test the programs and data on the plant-control computers
(5) If an error occurs, go back to steps (1) to (3) according to the error

As a result of the above operation procedure, the following problems might occur:
(1) The documents and programs might not match.
(2) It may be difficult to search the input/output process point used in the calculation, and the reference of characteristic curves.
(3) An understanding of the program is needed in order to create correct application data.

The above problems can happen even when the system is built by the vendor itself, so the possibility is higher when it is a collaboration between a vendor and a client. To prevent the above problems, Hitachi improved its "calculation data creation tool" as follows, and by using the new tool, it is possible to create calculation data on the online system without needing a thorough understanding of the calculation programs (see Fig. 3).

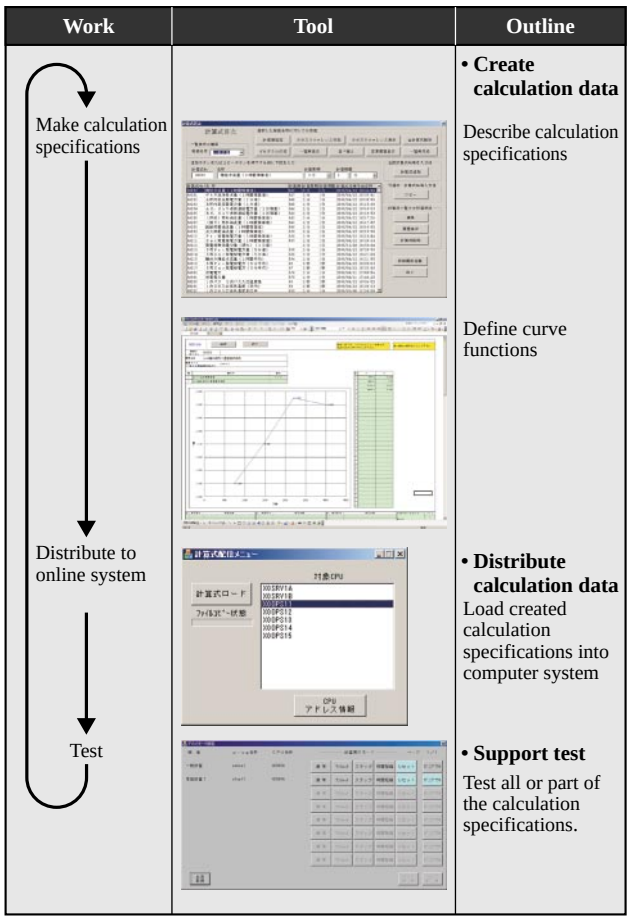


Fig. 3—Tool for Creating Calculation Data and Test. Example of tools used to create calculation data and develop test without requiring program details.

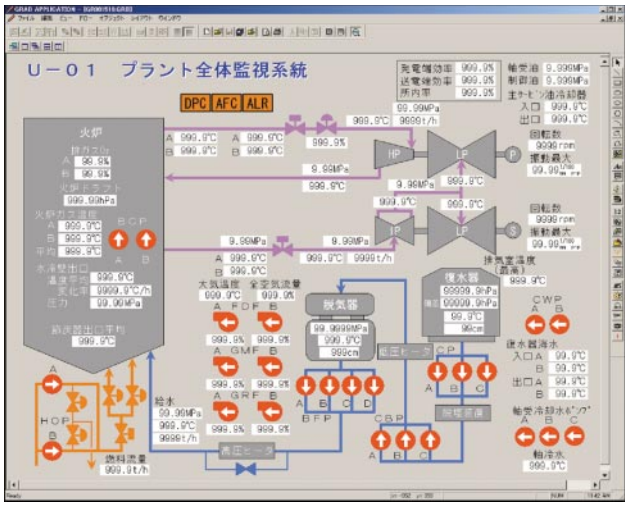
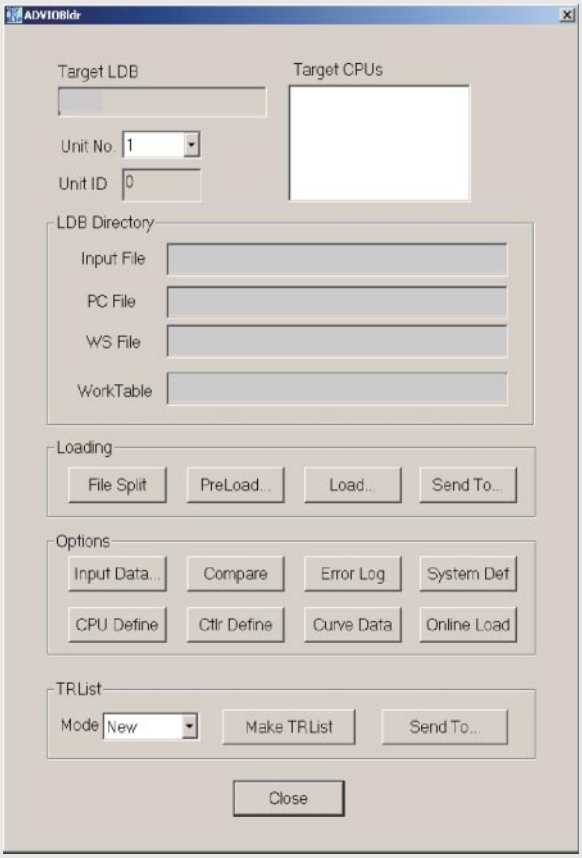


Fig. 4—Tool for Drawing Mimic Diagrams.
It is possible to assign process input points on the screens and to draw mimic diagrams.



*Excel is a registered trademark of Microsoft Corporation in the U.S. and/or other countries.

Fig. 5—Tool for Creating Process Point Information.
The tool to convert process point information created by Excel etc. to data that can be used in online computer system.*

Improvement in creating calculation data

(1) The programs are automatically created from the specification documents.
(2) Easy-to-understand description of calculation data
(3) Management of calculation data maintenance history
(4) Specification of calculation cycles and calculation orders
(5) Reference tool of input-output process points and characteristic curves
(6) Create and display characteristic curves
(7) Complete set of help functions

Improvement in distributing calculation data

(1) Specification of distribution destination of the program and data
(2) Management of distribution history
(3) Online switching of distributed programs and data

Improvement in test support

(1) One-time calculation
(2) Step-by-step calculation according to calculation sheet
(3) Shorter calculation cycles
(4) Tracing calculation output

Mimic Diagram Creation Tool

The “mimic diagram creation tool” was improved to be more intuitive and user-friendly, so that not only vendor engineers but also general users can use it to draw screens. With this tool, it is possible to assign input process points on screens and to draw process diagrams (see Fig. 4).

Process Input/Output Data Creation Tool

A set of user manuals for this tool was prepared so that general users can use the tool to easily create information on input/output process point (see Fig. 5).

CONCLUSIONS

In this article, we described the collaboration between TEPSYS and Hitachi, Ltd. on the computer control system replacement project of the Unit No. 6 of KASHIMA THERMAL POWER STATION for TEPCO.

By reflecting on problems that had arisen in previous projects, and by accepting advice from TEPSYS and instructions from TEPCO, we developed a set of sophisticated and convenient tools.

We will continue our efforts to improve and expand our user-friendly tools to make it possible to build application functions without requiring detailed knowledge of the software programs. We will also use

the improved solution to expand our collaboration with TEPSYS, and to contribute to the replacement of the supervisory computer control system for TEPCO.

ACKNOWLEDGMENTS

We would like to express our deep gratitude to all the people at TOKYO ELECTRIC POWER COMPANY and TEPCO SYSTEMS CORPORATION for their guidance and warm and continuous support.

REFERENCE

(1) "TEPCO Supervisory Computer Control System for Thermal Power Station [Reduced equipment investment in the replacement by own effort]," The Denki Shimbun (9 Jul. 2003) in Japanese.

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