

“MICREX-VieW” for Small and Medium-scale Monitoring and Control System Platforms in Energy & Environmental Fields

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ABSTRACT

Fuji Electric has supplied distributed monitoring and control systems to various fields. Recently, we have developed the monitoring and control system platform “MICREX-VieW” and its derivative “MICREX-VieW Compact”, which expand the range of applications for small and medium-scale systems and maximize compatibility with our existing systems. They feature high reliability through redundancy, resource inheritance for existing systems, automatic generation of control software by specification definition, and cost performance improvement due to the platform technology. They feature packages and templates for various fields and can be applied to broad fields including power generation plants, garbage incinerator plants, and food plants.

1. Introduction

Fuji Electric has supplied many distributed control systems (DCS) to power plants, petroleum plants, chemical plants, water treatment plants and the like for use in the energy and environmental fields. Fig. 1 shows the product line of distributed control systems provided by Fuji Electric. The “MICREX-NX” DCS provides high reliability through redundancy, and by leveraging its advantageous ability to realize safety instrumented functions and general instrumented functions with the same controller and engineering environment, is increasingly being used in applications to large-scale safety instrumented plants and the like.

Recently, Fuji Electric has developed the “MICREX-VieW” monitoring and control system platform for small and medium-scale applications that pro-

vides high reliability and maximizes compatibility with our existing systems.

The MICREX-VieW is a system that realizes high cost-performance by integrating operation and support system platforms and sharing hardware and control software. Additionally, the MICREX-VieW is a sustainable system capable of maintaining and inheriting various assets of existing systems, and flexibly supporting customer plans for equipment updating. For small-scale applications, Fuji Electric has developed the “MICREX-VieW Compact” small-scale monitoring and control system which is based upon the MICREX-VieW and configured from a programmable operation display (POD) and a general-purpose programmable logic control (PLC). This paper introduces features and application examples of the MICREX-VieW, the MICREX-VieW Compact, and their integrated support system.

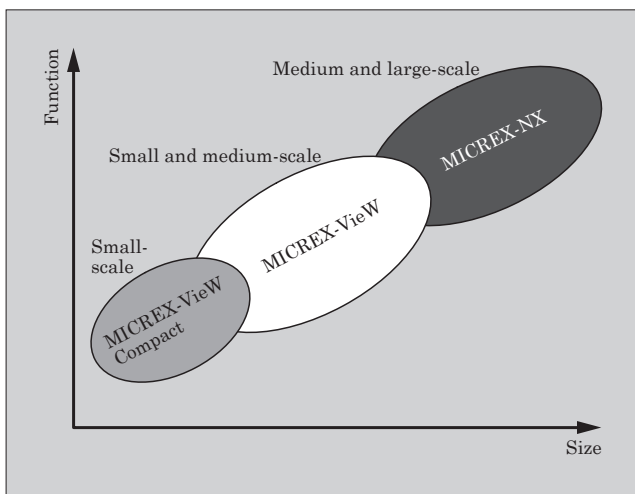


Fig.1 Lineup of monitoring and control system products

2. “MICREX-VieW” Small and Medium-Scale Monitoring and Control System Platform

2.1 Overview

The “MICREX-VieW” small and medium-scale monitoring and control system platform targets small to medium-scale plants, and allows redundancy of such components as the controller, network and human machine interface (HMI) to realize an optimal level of high reliability that meets customer needs. Use of the MICREX-VieW at the time of plant updating enables the maximum utilization of customer assets and the updating of plant equipment to be accomplished according to customer needs with the minimum investment. Moreover, in terms of operation and maintenance, the MICREX-VieW enhances plant visualization with minimal engineering cost and reduces the lifecycle cost of the entire plant.

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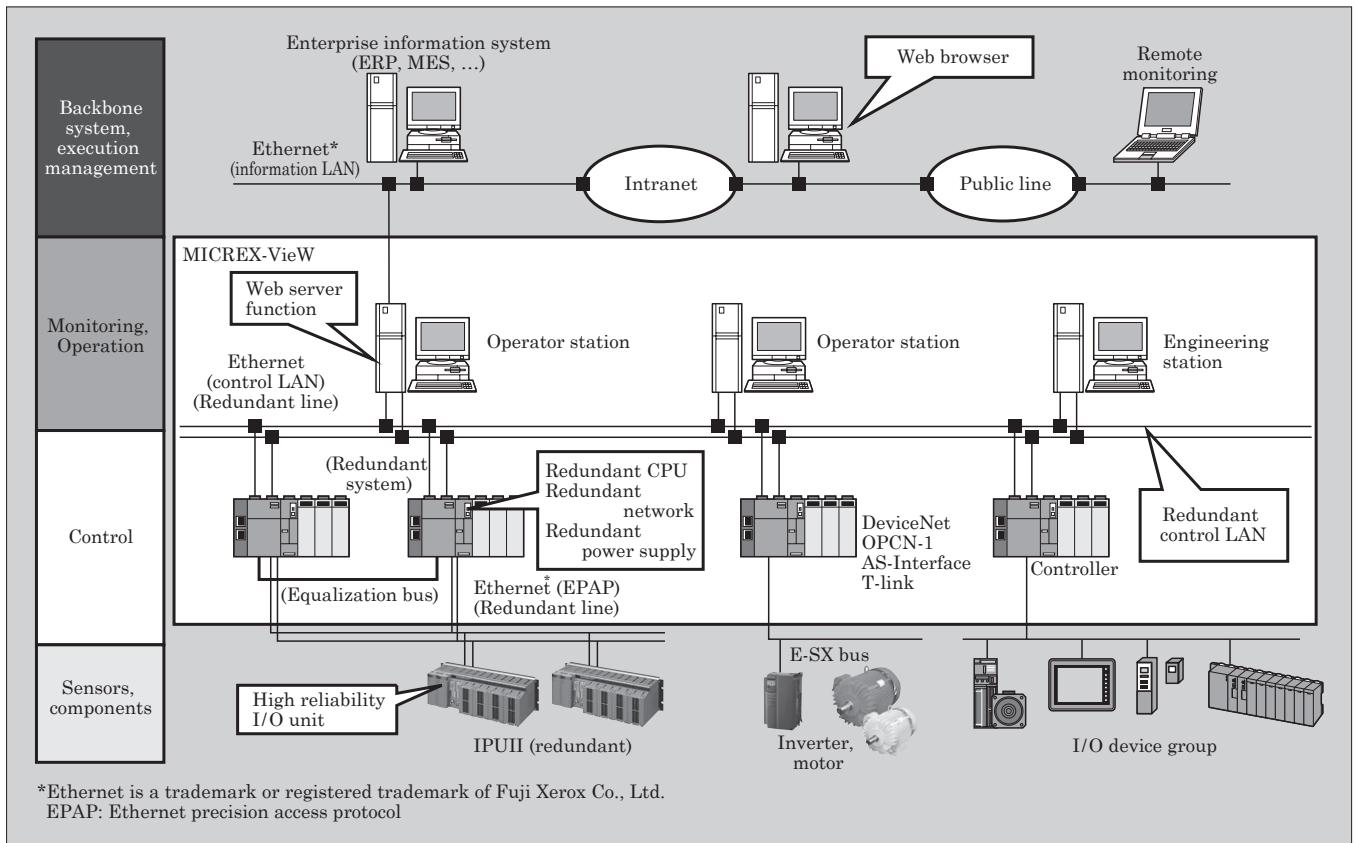


Fig.2 MICREX-View system configuration example

2.2 Features

- (1) Highly reliable system that supports stable operation

Figure 2 shows an example configuration of the MICREX-View system. With the MICREX-View, because components such as the operator stations, database, control LAN, controller CPU module, power supply, communication modules, I/O transmission path, I/O unit and the like can be made redundant as necessary, the optimal high reliability system can be built to realize stable operation. Additionally, all component elements of the I/O unit, i.e., the power supply module, bus interface module, internal bus, and I/O module (analog I/O module, digital I/O module) can also be made redundant.

In the case where an I/O module fails, the system can continue to operate while only the failed I/O module is isolated (fail-soft operation), and then after the failed I/O module has been replaced, recovery from the fail-soft operation can be carried out.

- (2) Hardware downsizing

The controller unit has combined Fuji Electric's PLC miniaturization and cost-lowering technology with the high reliability and control technology cultivated with DCS. The result is an approximate 70% reduction in size compared to the prior model.

- (3) Inheritance of various assets of existing systems

The updating of an existing DCS system is often

performed in piecemeal fashion, i.e., in stages according to the schedule of the customer. With the MICREX-View, interfaces to existing equipment are available for the HMI, controller and I/O unit so that these new units can be intermixed and used with other various units of an existing system. Accordingly, the HMI, controller and I/O unit can be updated independently in MICREX-View without having to modify the existing application software. Thus, updating can be performed in stages, with the HMI updated first, and followed by the controller and finally the I/O unit, for example. The plant monitoring screens of an existing system have typically been created with supervisory control and data acquisition (SCADA) software such as InTouch*¹, iFIX*² and Citect*³, and a single system may have than 100 such screens. The MICREX-View is configured such that varieties of SCADA software can be used as add-ins to the HMI platform so that the existing screen software can be ported without modification.

- (4) Visualization of equipment operating conditions, interlock, circuit status

*1: InTouch is a trademark or registered trademark of Invensys plc, USA

*2: iFIX is a trademark or registered trademark of General Electric Company, USA

*3: Citect is a trademark or registered trademark of Ci Technologies Pty. Limited, Australia

With Fuji Electric's DCS, equipment operating conditions and sequence conditions can be automatically generated from the control specification into the controller program by using the automatic conversion tool "HEART-BELIEVE." The resulting generated software can be monitored on an engineering station. With the MICREX-VieW, the operating conditions, interlock and circuit state, and the like generated with HEART-BELIEVE can be displayed automatically on an operator station, so that monitoring can be performed as part of the usual operation. Individual monitoring screens can be linked freely from the plant monitoring screen (see Fig. 3).

(5) Visualization from remote location

A remote monitoring function enables the monitoring screen of an operator station to be displayed and operated as-is from an office other than the monitoring room or from an offsite location, thereby making possible the remote visualization of the plant state.

An automatic email sending function can be used to acquire the alarm state and the plant state, thereby making possible unattended operation of the plant. Additionally, through coordinating with remote monitoring at Fuji Electric's call center, trouble can be responded to rapidly.

(6) High-level monitoring and control function

(a) Model predictive control (MPC)

Model predictive control, previously being only realizable on a PC or other dedicated device, has been implemented in the controller of the MICREX-VieW. As a result, MPC is easier to apply, has a higher level of reliability and can contribute to long-term stabilized control and labor-savings.

(b) Control performance monitoring (CPM)

In cases where adjustment is insufficient or, because of age-related deterioration or the like, the dynamic characteristics of the object to be controlled fluctuate and the control performance deteriorates,

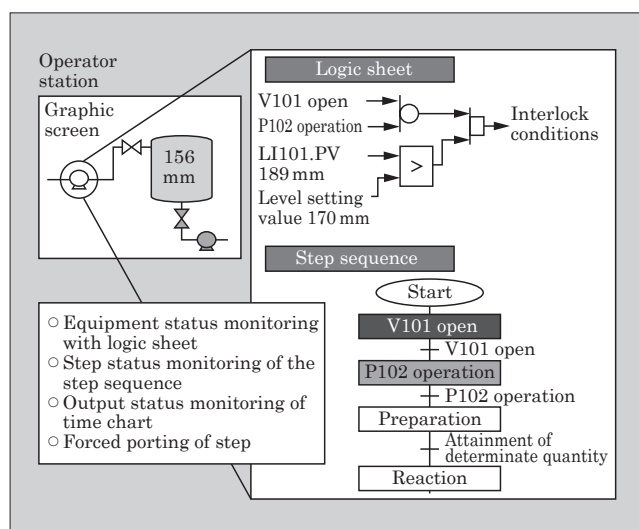


Fig.3 Visualization of equipment operating conditions, interlock, circuit status

the true control performance of the plant may not be demonstrated. A control performance monitoring function has been developed to detect such deteriorations in the control performance. By monitoring the control performance and detecting deterioration in that performance, the control can be readjusted and device maintenance performed in order to realize stable operation.

(c) Precise synchronization control

The "E-SX" bus, a high-speed synchronous control bus, has been developed. The throughput has been improved significantly, and high-precision multi-axis motion control can be performed for up to 8 axes at a control period of 0.25 ms.

(d) C language application software

C language application software can be installed in the CPU module to realize higher level control functions and information processing functions.

3. "MICREX-VieW Compact"

3.1 Overview

The "MICREX-VieW Compact" (VieW Compact) can be used to configure a compact monitoring and control system at the lowest possible cost. As shown on the left side of Fig. 4, the minimum configuration consists of a combination of only the programmable

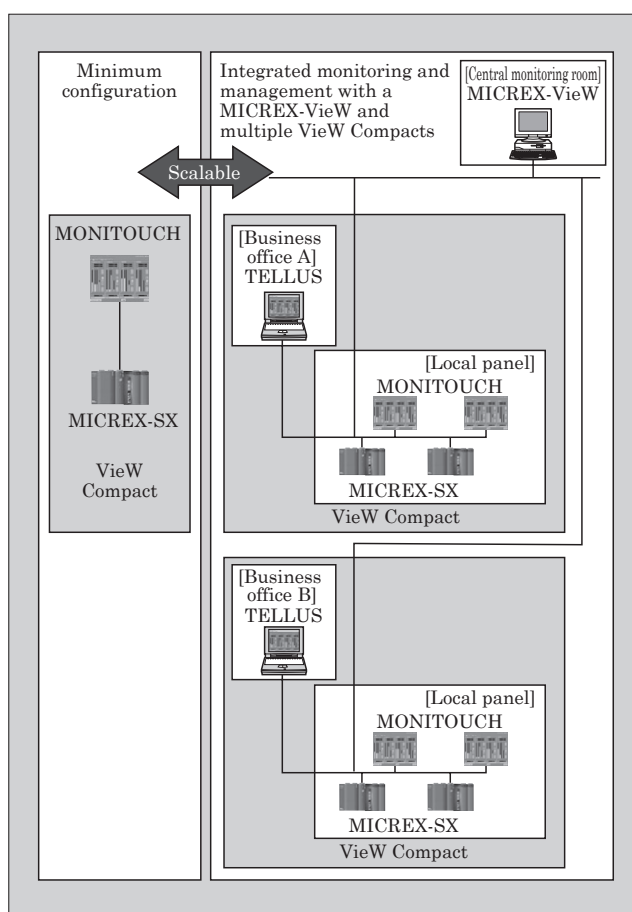


Fig.4 Scalable system configuration example

display “MONITOUCH” and the general-purpose PLC “MICREX-SX,” and is ideally suited for updating single loop controllers and the like. Moreover, flexible scalability allows for easy coordination with the MICREX-VieW system. Additionally, because of a common shared platform with the MICREX-VieW system, the aforementioned high-speed monitoring and control function can also be implemented in the VieW Compact.

3.2 Features

(1) Compatible package

The VieW Compact system can be used for electrical control and instrumentation control. For instrumentation applications, the View Compact is equipped with internal instruments (PID controller position-type output, PID controller velocity-type output, proportion computing unit, integrator, etc.) and input processing functions (temperature and pressure compensation, dead time generation, moving average, linearization, etc.), which are software packages in common with those of the MICREX-VieW of the host system. Variable gain and sample PI control, which have a proven track record with Fuji Electric's single loop controller, can also be supported. By implementing optimal control with diverse functions, the VieW Compact can be used to reduce energy consumption, and applied to control systems, such as for boilers that reduce the emissions of substances harmful to the environment, or other types of control.

(2) Scalable system structure

With a configuration that is scalable according to the size of the control system and the application, the VieW Compact can be applied to plants and equipment optimally. The system can be used in scalable, i.e. the number of devices per PLC is selectable from 2 to 32, and it can provide various configurations from the smallest system having a 1:1 ratio of standalone PLC and programmable operation display, to large system with multiple PLCs, and configurations combined with the host system. Additionally, by installing “TELLUS”, the same screen as shown on the programmable operation display can be displayed and manipulated on a PC, so that monitoring and operations can be performed from a business office and the like (Fig. 4).

Depending on the scale, 48 K steps or 256 K steps can be selected for the PLC. Additionally, high-reliability redundant controllers are also supported. The programmable operation display has excellent environmental durability and is suitable for onsite installation. Display screens are available in 8-inch, 10-inch, 12-inch and 15-inch size variations, and can be selected as necessary.

A VieW Compact used in a small-scale plant may easily be enlarged in the future corresponding to an expansion of the monitoring and control operations. Flexible scalability is also supported, such as subse-

quent add-on installation of the VieW Compact to an existing monitoring and control system such as the MICREX-VieW for the purpose of localized onsite monitoring and control.

4. Integrated Support System

4.1 Overview

The integrated support system is able to integrally manage support tools and application software, which previously existed separately for each device. This system aims to reduce the total cost of ownership (TCO) through engineering for high quality and improved maintainability (Fig. 5).

4.2 Features

(1) Integrated support system

With the integrated support system, the execution of unified operations such as batch backup with a single action, and the integrated management of application software for each tool have the net effect of reducing human error. As shown in Fig. 5, a system configuration diagram can be created, and a support tool for each device can be activated from that screen. Moreover, because the automatic generation of system definitions, device adjustment, network start-up, diagnosis, maintenance, etc. can be performed at a single location from the system configuration diagram, maintainability is improved.

(2) Compliance with international standard

Support tools for the controller comply with the IEC 61131-3 (JIS-B3503) international standard and can be used worldwide. Applications can be created using ladder language (ladder diagrams), function block diagram (FBD) language, structured text (ST) language, instruction list (IL) language, and sequential function chart (SFC) language.

(3) Automatic generation of control software according to specification description

HEART-BELIEVE is a tool for creating control function specifications such as instrumentation flow diagrams, interlock block diagrams (IBD) and the like

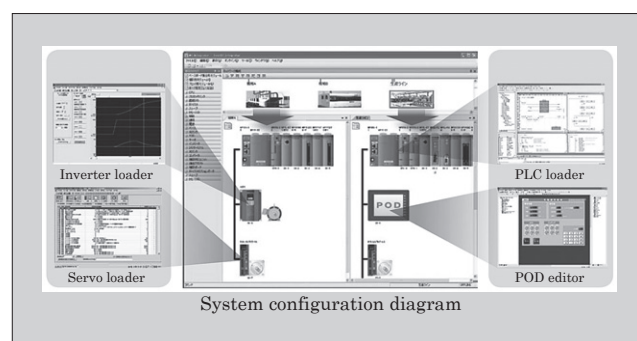


Fig.5 Integrated support system

*4: Visio is a trademark or registered trademark of Microsoft Corporation, USA and its affiliates

by using Visio*⁴ general-purpose office automation software. By automatically generating control application software for the controller from the created control function specifications, the engineering work efficiency can be improved and high quality application software can be realized. Moreover, the creation and editing of specifications can be accomplished easily by dragging and dropping function symbols.

The control function uses a platform independent model (PIM) that can continue to operate even if the platform changes. Additionally, by developing platform specific models (PSMs) for required platforms, a structure that supports multiple platforms can be built. Because platforms ranging from PLCs for small-scale systems to DCS controllers for large-scale systems are supported, the range of possible applications is wide (Fig. 6).

In accordance with the control function specifications, the state during operation with a PLC can be monitored and engineering work, ranging from the creation of specifications to onsite adjustment, operation and maintenance, can be comprehensively supported.

(4) Simulation function that runs on a PC

A simulation tool that can execute simulation of a system connected with multiple HMIs and controllers has been developed for use on a single PC (Fig. 7).

By testing the created application software to-

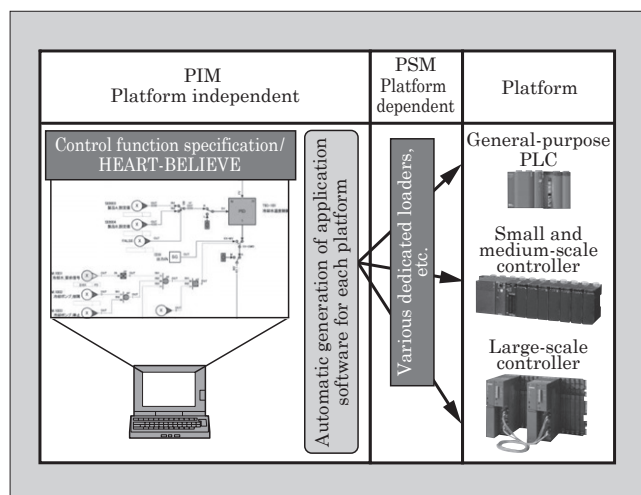


Fig.6 Platform independent application software generation

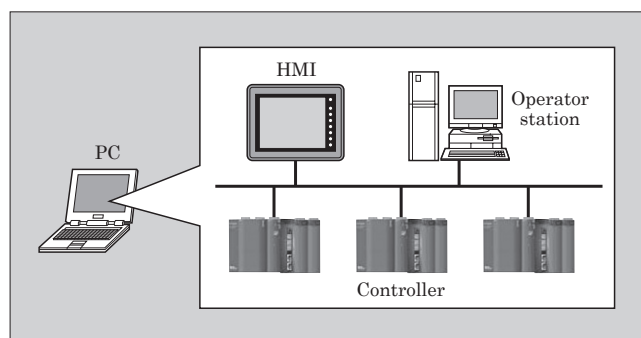


Fig.7 Combined simulation of HMI and multiple controllers

gether with an HMI as a system, without using actual devices, the quality of the application software can be improved prior to actual physical testing.

Additionally, by combining the simulation function with a plant simulator or an apparatus simulator, simulations that closely resemble an actual plant or equipment are possible.

5. Application Examples

The MICREX-VieW and the VieW Compact can be used as control systems for various types of small and medium plants. Several examples of applications to the energy and environment fields are presented below.

5.1 Monitoring and control system for geothermal power plant

With the aim of establishing a low carbon society and in consideration of the problem of electric power shortages, geothermal power plants are attracting attention as a renewable energy source. Geothermal power plants have much lower CO₂ emissions than thermal power plants that use fossil fuels such as oil and coal, and in terms of global environmental protection, are an excellent method for generating power. A geothermal power plant captures geothermal steam from a steam producing well, and rotates a steam turbine to generate electricity.

Figure 8 shows an example of the MICREX-VieW applied to a geothermal plant monitoring and control

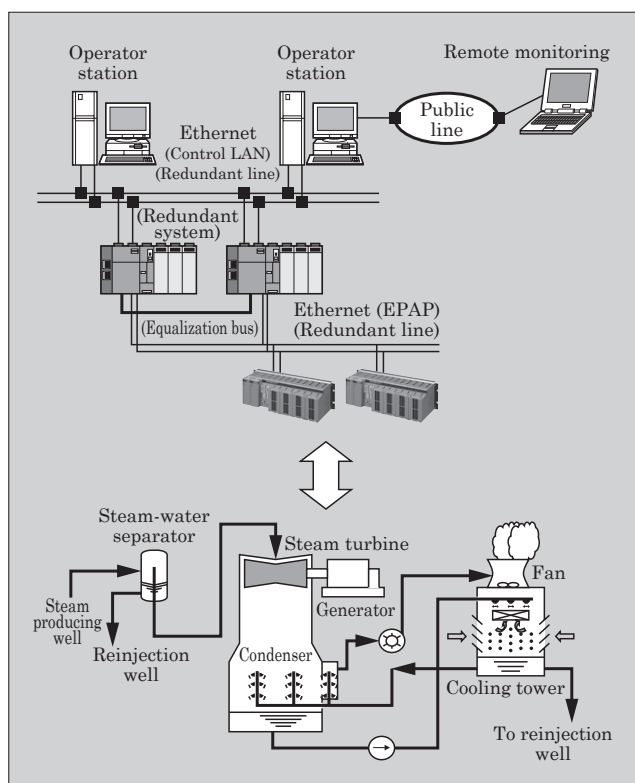


Fig.8 Geothermal power plant monitoring and control system

system. The steam flow rate from the steam producing well and the pressure are controlled with this system, and high reliability is required. The system is configured using redundant operator stations and controllers for high reliability. Additionally, because operation during the nighttime is unattended, the automated e-mail sending function of the MICREX-VieW is used to transmit process error signals and the like. The MICREX-VieW is also provided with a function for switching between multiple languages and is ideal for applications overseas where many geothermal power plants exist.

5.2 Monitoring and control system for waste incineration plant

A waste incineration plant is a plant that incinerates municipal waste, and in addition to controlling the combustion, must also limit the generation of dioxins and the emission of toxic gas to within regulated levels. The MICREX-VieW is equipped with automatic combustion control (ACC), and through implementing optimal control for an incineration plant, is able to minimize the generation of dioxins and the amount of sulfur oxide (SO_x) and nitrogen oxide (NO_x) emissions released into the atmosphere. The MICREX-VieW also contributes to the effective utilization of energy by monitoring and controlling the power demand, performing selective trip coordination and the like, and selling electric power back to the power companies.

Further, one characteristic of waste incineration plants is that compatibility with existing applications is strongly required at the time when updating the control system. Because the software of the MICREX-VieW has a high level of compatibility, the amount of engineering work can be reduced. Moreover, HMIs, controllers and I/O units can be gradually updated in piecemeal fashion so as to minimize the plant downtime (Fig. 9).

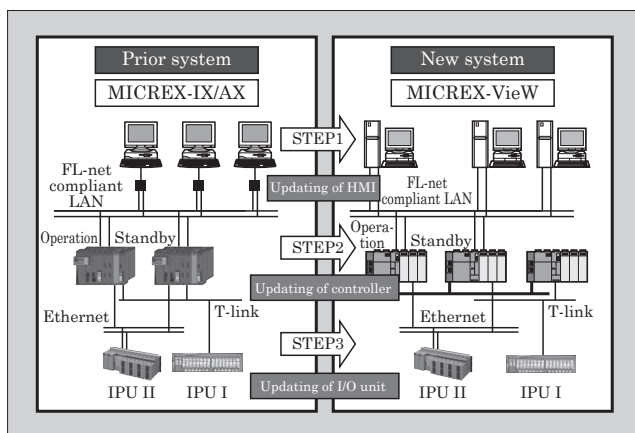


Fig.9 Gradual updating of a waste incineration plant management and control system

5.3 Management, monitoring and control system for food plant

A food plant is a type of batch plant in which control functions center on batch sequences in the manufacturing process and sequence control in cleaning process and the like.

In the food plant management, monitoring and control system shown in Fig. 10, brand management and sequence control for manufacturing processes is performed with the MICREX-VieW and Fuji Electric's "FLEXBATCH" brand management system, and schedule management, results management and the like are performed with the combination of a host system manufacturing execution system (MES) and a traceability system.

In the food industry, in response to social conditions concerning food and an increase in citizen awareness of food safety, manufacturing management and quality management in a plant must be implemented rigorously and information management is needed. A traceability system, in conjunction with a MES and a monitoring and control system, associates raw material number with manufacturing and shipping lot numbers to realize history management of the food manufacturing processes.

In the event of a defective product such as due to contamination, the history management mechanism can be utilized to issue instructions rapidly to recover products from consumers or to stop selling the products, thus supporting the provision of safe food to consumers.

5.4 Updating the control apparatus in a small-scale facility

The following is an example in which the VieW Compact is used for updating an existing single loop controller in the control apparatus of a small-scale facility or turbine, boiler or the like (Fig. 11).

Utilizing the advantageous feature whereby existing single-loop controllers can be gradually updated

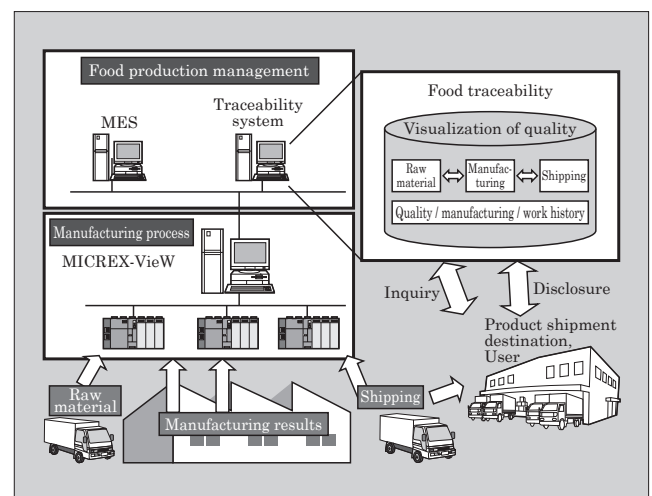


Fig.10 Management, monitoring and control system for food plant

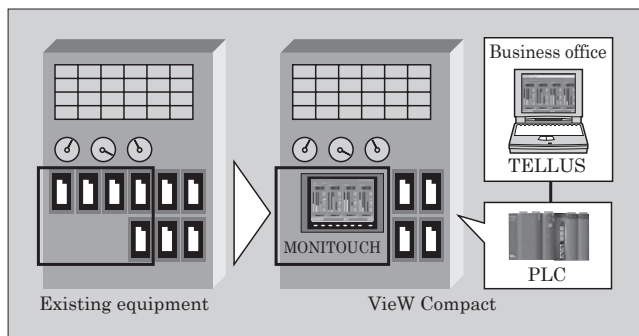


Fig.11 Updating of control equipment in small-scale facility

in stages of several units at a time, five single-loop controllers were updated at first. Housing a high-reliability redundant PLC inside the existing panel and mounting the MONITOUCH programmable operation display on the surface of that panel provides high-performance operation without any sense of unfamiliarity compared to the existing equipment. In consideration of the amount of engineering work needed

and the post-operation support maintenance, HEART-BELIEVE was used for the PLC software.

Plant and equipment visualization can be enhanced by installing TELLUS in a notebook PC located in a business office and establishing a configuration in which monitoring is possible.

6. Postscript

This paper has presented an overview and descriptions of the features of the small and medium-scale monitoring and control system platform “MICREX-View” and its derivative “MICREX-View Compact” for use in the fields of energy and the environment. Fuji Electric intends to continue to supply high performance, high quality systems and solutions through responding accurately to customer needs for asset inheritance, gradual updating in stages, improved maintainability and the like, and aiming to further increase customer satisfaction.



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