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Electric Power Distribution and Utility Monitoring System for Better Energy Visualization

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OVERVIEW: EMSs use IT functions such as visualization for the efficient management of energy use. They are also known as FEMSs when used in factories, BEMSs when used in buildings, and HEMSs when used in the home. In the market for remote monitoring systems, few small- to medium-sized sites with power supply contracts of less than 1,000 kW have installed EMSs in the past. Recently, however, this has changed, with the introduction of subsidy schemes leading increasing numbers of such sites installing EMSs. Hitachi Industrial Equipment Systems Co., Ltd. supports energy efficiency, the environment, preventive maintenance, and productivity management through its range of products, which include not only large systems, but also simple energy monitoring systems for small- or medium-sized sites that do not require an always-on PC.

INTRODUCTION

A survey of the Japanese market for commercial energy management systems (EMSs) found that it has continued to grow year by year. The market can be divided into the following categories, (1) Central monitoring systems - system integration, (2) Central monitoring systems - energy management services, (3) Supply of remote monitoring systems and energy management support services, and (4) Energy analysis and consulting. In addition to the replacement of existing large systems, the market is also being boosted by growth, from a low base, in the installation of EMSs by small- and medium-sized businesses (see Fig. 1).

There has been an increase in the installation of equipment for demand monitoring since the Great East Japan Earthquake in March 2011, and subsequently the beginning of a shift, since the latter half of FY2011, toward the use of EMSs for management based on recently acquired experience with power saving policies to help alleviate the summer peak in electric power demand.

Although the Japanese market for EMSs in FY2012 saw increases in the installation of EMSs at both large sites and small- or medium-sized sites, it is installation at small- or medium-sized sites that will drive the EMS market in the future.

Whereas products belonging to market categories (1) and (2) (central monitoring systems - system integration and central monitoring systems - energy management services) are primarily supplied to large factories or office buildings, the low initial and running costs of categories (3) and (4) (supply of remote monitoring systems and energy management support services, and energy analysis and consulting) mean they tend to be supplied to small- or medium-sized sites (see Fig. 2).

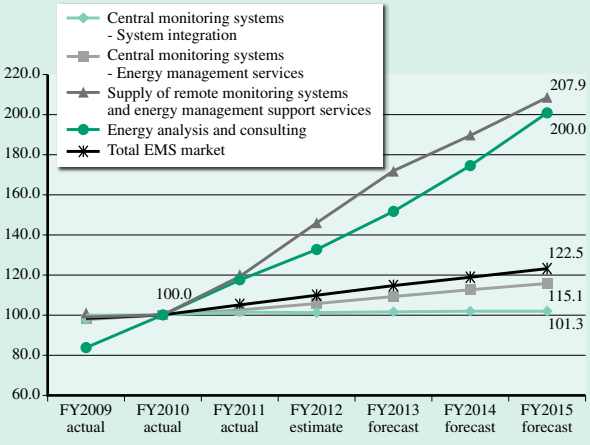

Fig. 1—Sales Index (Relative to Actual Sales in 2010).
The EMS market continues to grow year after year. In addition to the replacement of existing large systems, the market is also being boosted by growth, from a low base, in the installation of EMSs by small- and medium-sized businesses.

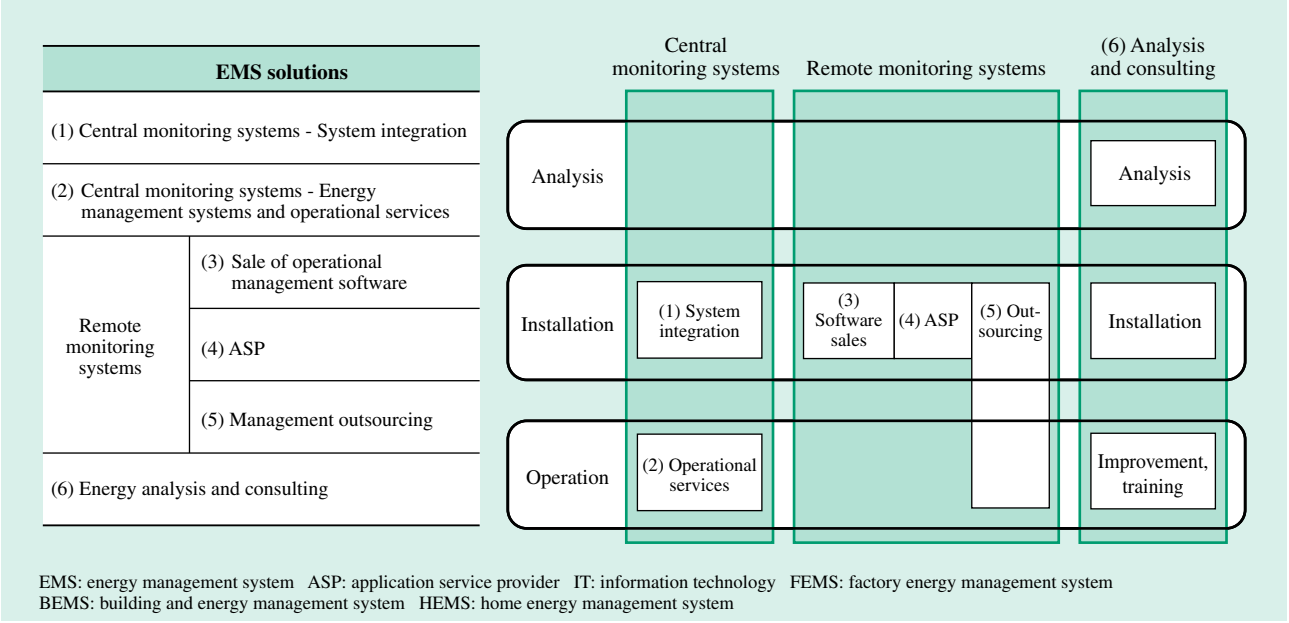

Fig. 2—Definition of IT-based EMS Solutions.
EMSs use IT functions such as visualization for the efficient management of energy use. They are also known as FEMSs when used in factories, BEMSs when used in buildings, and HEMSs when used in the home.

The following is a summary of the Bill to Partially Amend the Act on the Rational Use of Energy (Energy Conservation Act) of 2013.
(1) Introduction of a scheme for recognizing energy consumers who, in addition to conventional energy saving measures, also take steps to reduce their use of grid power during demand peaks using technologies such as batteries, on-site power generation, or energy management systems [factory energy management systems (FEMSs), building and energy management systems (BEMSs), or home energy management systems (HEMSs)].
(2) Specifically, the calculation for savings targets (a mean 1% annual improvement in unit energy consumption) was revised to make achieving the target easier by recognizing steps (energy savings) taken during periods of peak demand to reduce use of grid power.

Various subsidy schemes have also boosted the market for EMSs. These include the "FY2014 subsidies for supporting business operators that strive to rationalize their energy use," an energy efficiency subsidy to be offered by the Ministry of Economy, Trade and Industry (METI) in FY2014. This extended the subsidy to cover costs associated with the use of EMSs for energy saving measures or for managing peak demand.

Hitachi's product range already included the electric power distribution and utility monitoring system for large or medium-sized sites. It has now added simple energy monitoring systems for small- or medium-sized sites that do not require an always-on personal computer (PC).

This article describes the electric power distribution and utility monitoring system for large or medium-sized sites.

ELECTRIC POWER DISTRIBUTION AND UTILITY MONITORING SYSTEM

The electric power distribution and utility monitoring system provides data collection software that runs on a PC together with multi-circuit units and clamp-on current sensors to allow those energy consumers who are designated as using energy management to collect environmental and energy efficiency data economically (see Fig. 3).

Up to 121 electric power distribution and utility monitoring system units can be connected to each system running the DE-SWA data collection software, and the communication lines between units can be up to 4.8 km in length.

A measurement data screen is provided to display realtime measurement data and status information from each electric power distribution and utility monitoring system unit. Similarly, the demand monitoring screen supports five channels of demand monitoring and provides 30-minute demand forecasts.

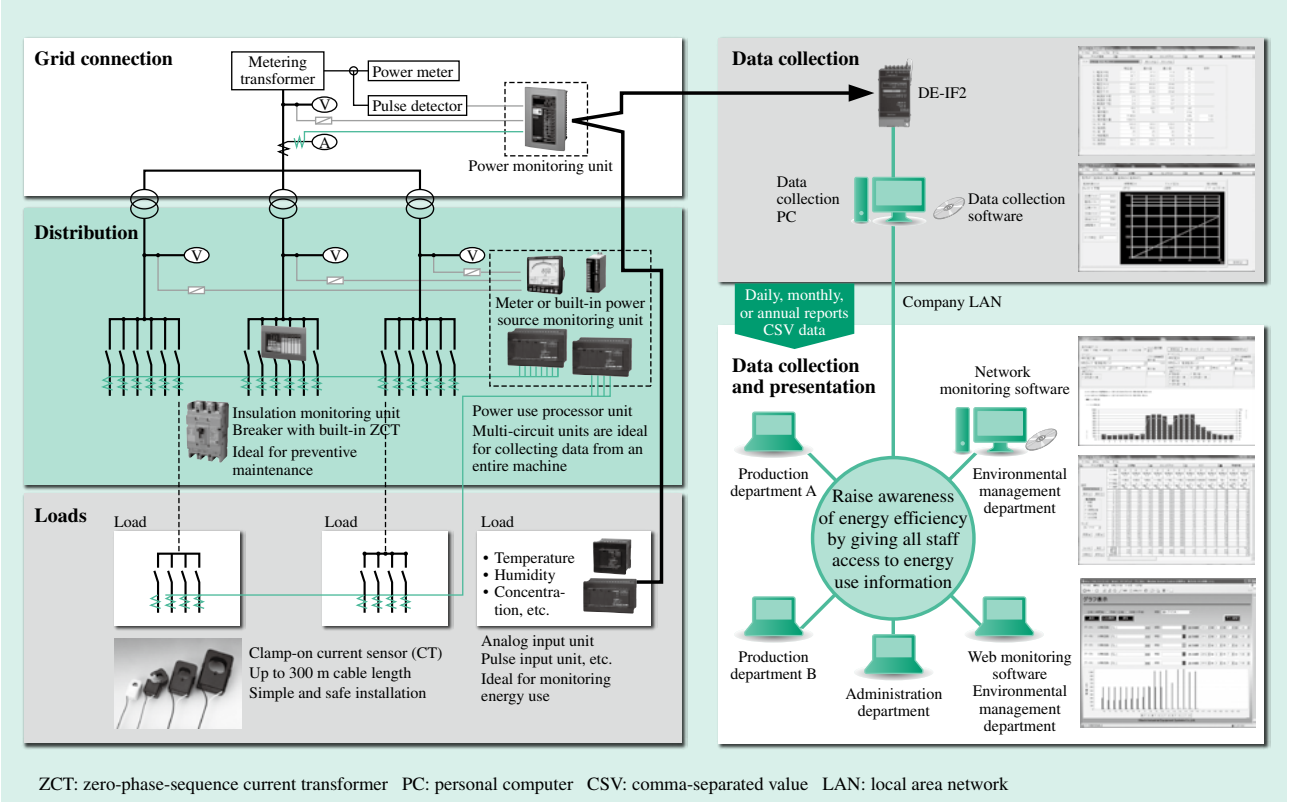

Fig. 3—Example System Block Diagram.
Environmental and energy efficiency data can be collected economically using Hitachi's electric power distribution and utility monitoring system for large or medium-sized sites.

An alarm is output if the predicted demand exceeds a preset level, and the alarm data is recorded. Trend screens display daily, monthly, and annual trends. They can also display multiple variables, allowing parameters to be compared with their past values or with different parameters from the same time period. The reporting screens, meanwhile, can be used to display, print, or edit daily reports dating back one

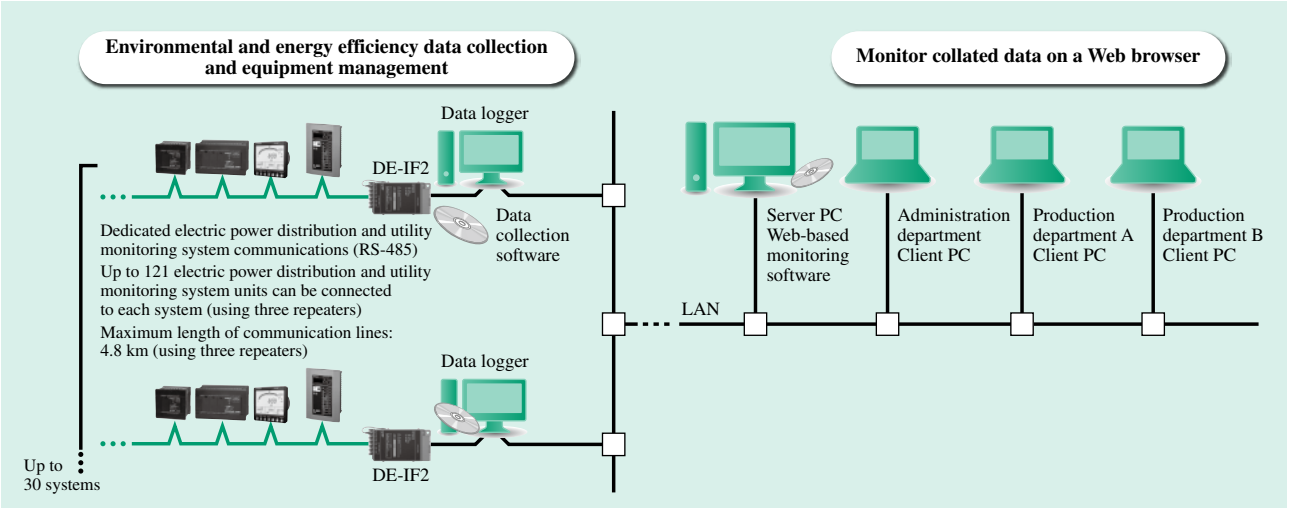

Fig. 4—Example Block Diagram of System for Environmental and Energy Efficiency Data Collection and Collation of Data for Monitoring.
Up to 121 electric power distribution and utility monitoring system units can be connected to each system running the DE-SWA data collection software, and communication lines can be up to 4.8 km in length.

month, monthly reports dating back two years, or annual reports dating back 10 years.

The daily, monthly, and annual reports can also be saved in comma-separated-value (CSV) file format to allow user editing in Microsoft Excel* or other spreadsheet software. Hitachi also offers the DE-WEB Web-based monitoring software for displaying measurement data graphs or reports, collated from CSV data, in a Web browser.

DE-WEB can collate daily reports of hourly data for up to 30 DE-SWA systems. These functions are described below (see Fig. 4).

(1) Trend graph display

Displays up to five graphs of the same variable (see Fig. 5).

(2) Report display

Stores up to 100 pages with 24 columns of daily (by hour), monthly (by day), and annual (by month) reports (see Fig. 6).

(3) Departmental classification function

Specifies up to four levels of unit measurements (cumulative values), collates (adds up) departmental categories, and presents the results in graph or tabular form.

(4) Virtual circuit function

Performs arithmetic operations on unit measurements to calculate virtual measurements for locations that have no sensor, and presents the results in graph or tabular form.

(5) Carbon dioxide (CO_2) emissions function

Uses cumulative energy data, such as use of electric power or gas, and predefined CO_2 emission coefficients to calculate CO_2 emissions, and presents the results in graph or tabular form.

(6) Unit consumption function

Uses cumulative energy data and predefined or measured unit consumption factors to calculate the (cumulative) amount of energy required to produce a unit quantity of product, and presents the results in graph or tabular form.

EXAMPLE ELECTRIC POWER DISTRIBUTION AND UTILITY MONITORING SYSTEM INSTALLATION

Hitachi installed electric power distribution and utility monitoring system at the Nakajo and Narashino Administrative Division Hitachi Industrial Equipment Systems Co., Ltd. in 1993 and 2000, respectively in order to make energy data available for formulating and implementing energy saving measures. Both plants have since been recipients of METI Minister Awards for excellence in energy management in recognition of the energy efficiency benefits of electric power distribution and utility monitoring system. The plants have also been designated as “Super Eco-factories” by Hitachi, with visitors from all over Japan coming to learn from that know-how.

Both plants have had electric power distribution and utility monitoring system units installed throughout their operations, from the extra-high-tension substation that connects to the power company grid, to the machinery that consumes the power. A monitoring PC collects data from each unit at 10-minute intervals and presents daily reports in tabular or trend graph form in 10-minute, 30-minute, or one-hour increments. The system outputs an alarm if the contracted maximum of 3,300 kW is at risk of being exceeded, causing the

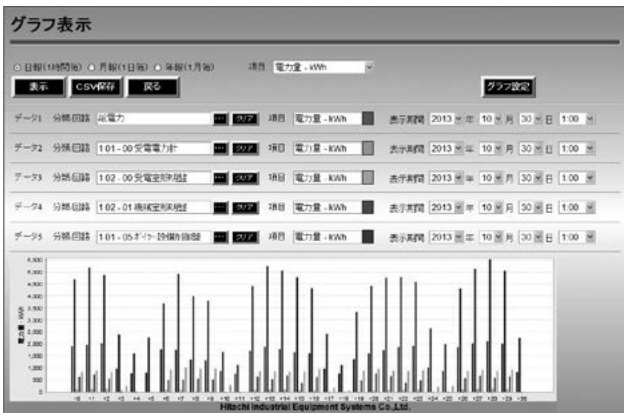

Fig. 5—Trend Graph Screen.
The DE-WEB Web-based monitoring software can display collated measurements in graph or tabular form. Up to five graphs of the same variable can be display at the same time.

Fig. 6—Report Screen.
The reporting function can store up to 100 pages with 24 columns of daily (by hour), monthly (by day), and annual (by month) reports.

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

plant air conditioning or other loads to shut down automatically. Because the system can also be used to check the operational status of machinery, it can assist with improvements by looking at workload balance or idle times.

Utilizing power data monitoring, the plants were able to significantly reduce the number of transformers on site by identifying the appropriate transformer capacities and consolidating on low-loss amorphous transformers. This reduced power losses to one-third of their previous levels, delivering annual savings of several million yen.

Similarly, an analysis of compressor power use found that they were consuming electric power at 65% of rated capacity, even when idle. Hitachi was able to minimize this idling by installing inverter-driven compressors that can adjust to changing loads. These operational improvements provided annual savings of several million yen.

CONCLUSIONS

Through the centralized management and analysis of integrated energy data, including water and gas as well as electric power, utilities data such as temperatures and concentrations, and protection data such as data from low-voltage insulators, electric power distribution and utility monitoring system provides extensive support for energy savings, the environment, preventive maintenance, and productivity management. Hitachi hopes this article will prove useful to anyone installing an EMS.

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