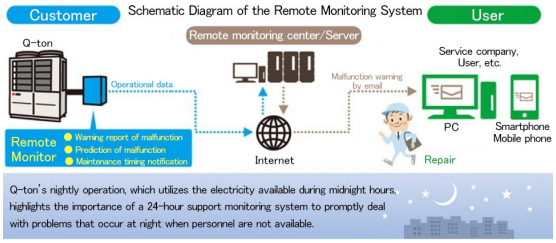
Energy-saving Proposals and Maintenance Services through 24-hour Remote Monitoring System of CO_2 Heat Pump Water Heater



Sales Department
Air-Conditioning & Refrigeration Division
Air-Conditioning & Refrigeration Quality Assurance Department
Quality Management Division
Machinery, Equipment & Infrastructure

In recent years as part of global warming prevention, heat pump hot water supply systems, which are highly efficient and emit less CO_2, are attracting attention as an alternative to boiler systems in which natural gas, heavy oils or kerosene is used. The ESA30-25 CO_2 refrigerant heat pump water heater of Mitsubishi Heavy Industries, Ltd (MHI) has achieved the industry's highest COP of 4.3 and maintains 30 kW output at ambient temperatures of up to -7°C. Even in extremely cold regions where the ambient temperature may reach -25°C, it can discharge hot water of 90°C, thus exhibiting performance superior to the products of our competitors. However, because the CO_2 refrigerant heat pump water heater involves a large high/low pressure difference and contains a water circuit, etc., regular maintenance inspections (e.g., regarding blockages or leaks in the circuit or a decline in performance) are required. The 24-hour remote monitoring system, which is introduced in this report, enables the accurate, prompt and timely provision of these maintenance services to our customers, as well as proposals for more economical ways of using the water heaters (energy-saving operation). It therefore assists customers with the long and stable use of our water heater products.

1. Service outline

(1) Provision of support services for energy-saving operation

In our monitoring system, suggestions based on the monitored data analyses will be made regarding the optimum schedule of filling the hot water tank to cause no excesses/shortages of hot water. The energy consumption by the water heater and the amount saved due to the energy-saving effect, etc., are also reported regularly.

Figure 1 shows an example of eliminating the unnecessary operation of a water heater, based on the suggested filling schedule of the hot water tank.

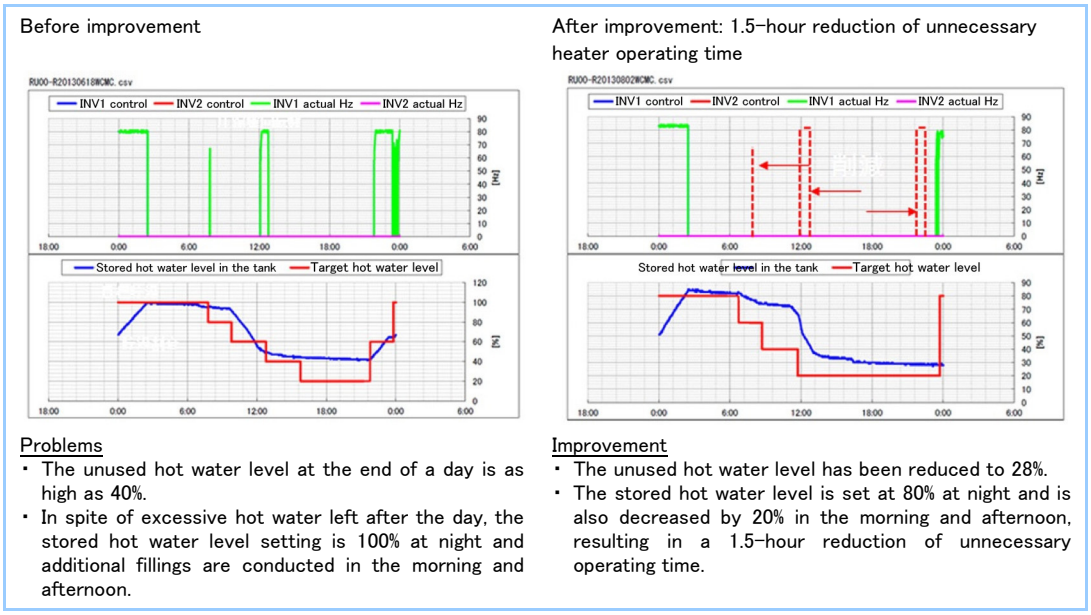


Figure 1 Energy-saving effect induced by the suggested filling schedule of the hot water tank (an example of improvement)

Figures 2 to **4** are examples of the visualized energy consumption and cost-reduction effect based on the regular reports.

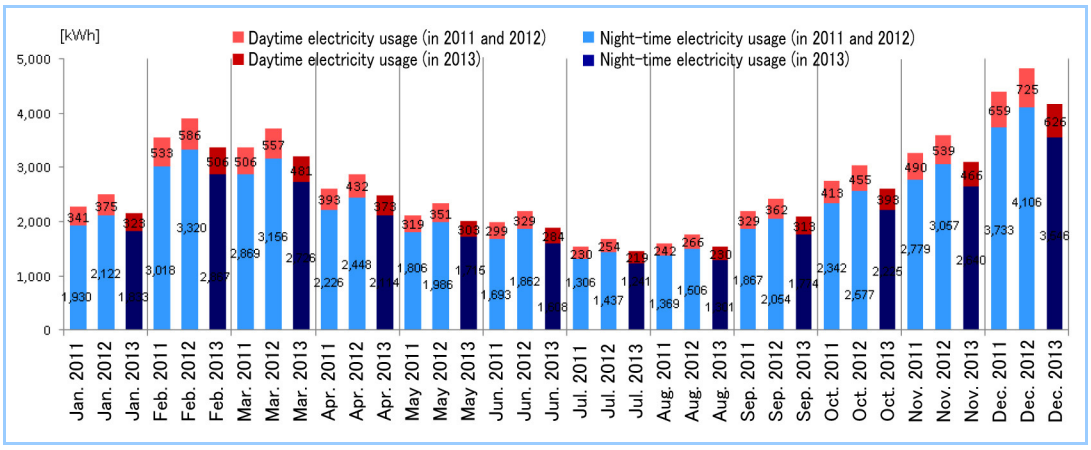


Figure 2 Electricity usage comparison (a comparison of energy consumption)

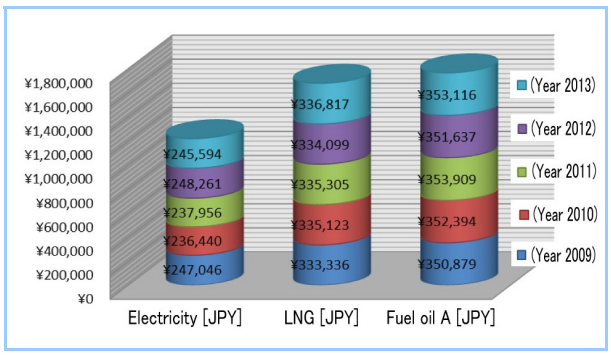


Figure 3 Cost comparison with the alternative energy sources of electricity (an example of total cost comparison)

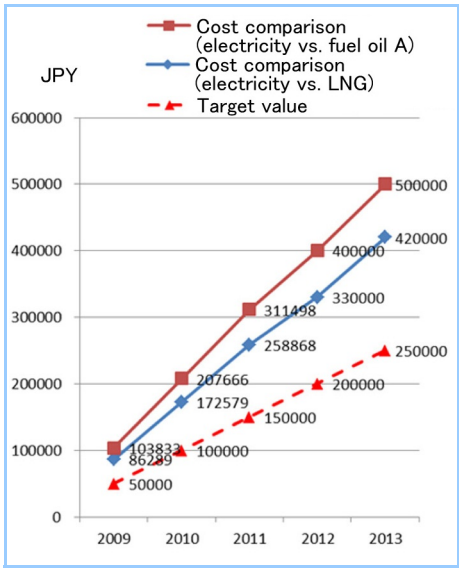


Figure 4 Cost comparison with alternative energy sources of electricity (an example of cost difference comparison)

(2) Provision of preventive maintenance services for the device

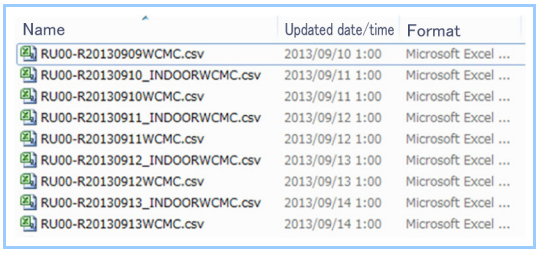
The monitoring system allows the detection of abnormal device conditions based on the analyses of monitored data on hot water discharge temperature, water heat exchanger performance, pressure sensors readings, operation modes, presence/absence of protection control, compressor operating conditions, etc. It therefore enables the provision of preventive maintenance services before precarious conditions can cause real damage to the device. With this service, we can assure our customers of the long and stable use of our water heater products.

By making suggestions through monitoring data-based preventive maintenance services and making use of such activities, retailers and customer service centers can also enhance the quality of aftercare services, establish a connection with customers and utilize opportunities for obtaining new orders

(3) Provision of prompt service in response to malfunctions

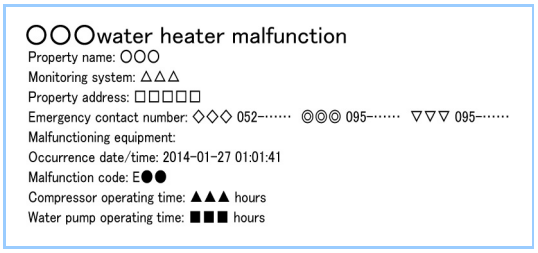
In the case of damage to a device, our monitoring system is capable of making a warning on malfunction by email with the operational data obtained immediately before the occurrence of a malfunction (**Figures 5** and **6**). Through this email, the service personnel in charge will be informed of the relevant property name, address, contact number and type of malfunction. The likely cause can also be identified by comparing past operational data with the latest data before the malfunction occurred. Consequently, prompt repair/recovery service can be provided,

minimizing the interruption of the continuous use of our water heaters. We thereby can assure our customers that they can benefit as much as possible from the economic advantages resulting from the use of our products.



Name	Updated date/time	Format
RU00-R20130909WCMC.csv	2013/09/10 1:00	Microsoft Excel ...
RU00-R20130910_INDOORWCMC.csv	2013/09/11 1:00	Microsoft Excel ...
RU00-R20130910WCMC.csv	2013/09/11 1:00	Microsoft Excel ...
RU00-R20130911_INDOORWCMC.csv	2013/09/12 1:00	Microsoft Excel ...
RU00-R20130911WCMC.csv	2013/09/12 1:00	Microsoft Excel ...
RU00-R20130912_INDOORWCMC.csv	2013/09/13 1:00	Microsoft Excel ...
RU00-R20130912WCMC.csv	2013/09/13 1:00	Microsoft Excel ...
RU00-R20130913_INDOORWCMC.csv	2013/09/14 1:00	Microsoft Excel ...
RU00-R20130913WCMC.csv	2013/09/14 1:00	Microsoft Excel ...

Figure 5 Example of released operational data



○○○water heater malfunction
Property name: ○○○
Monitoring system: △△△
Property address: □□□□□
Emergency contact number: ◇◇◇ 052-····· ◎◎◎ 095-····· ▽▽▽ 095-·····
Malfunctioning equipment:
Occurrence date/time: 2014-01-27 01:01:41
Malfunction code: E●●
Compressor operating time: ▲▲▲ hours
Water pump operating time: ■■■ hours

Figure 6 Malfunction warning email (an example)

2. Outline of the remote monitoring system

Our remote monitoring system consists of the master unit (RM-FGW) and the remote terminal board (RM-PWB) and uses a customer's LAN to send monitored data to the MHI server via the Internet (**Figure 7**). Therefore, the speed of communications in our system is faster than the telephone line systems which our competitors have adopted for remotely monitoring air conditioners. No special communication fees (payment for phone calls) are charged.

A single master unit (RM-FGW) can handle the monitoring of the operational data of 32 CO_2 water heaters (Q-ton) and the data monitoring interval can be set as short as 10 seconds, which is 6 times more detailed than other companies (shortest interval of 1 minute).

Because the data is transmitted in such a way that the data for a day (i.e., 24-hour operational data) is compressed and collectively sent to the MHI server once a day, the load on the customer's LAN can be decreased compared with the method in which operational data is constantly reported to the server. For example, when reporting the monitored data of a single water heater (Q-ton), approximately 5 seconds are required to complete data transmission with a communication speed of 1 Mbps.

On the other hand, the collected operational data, which has been compressed and encoded to prevent third parties from browsing it, is decompressed and decoded before being converted into a data format that can be browsed from retailers or customer service centers (special software is necessary for data browsing). Through the disclosure server, the data becomes available for login users. Based on this data, retailers and customer service centers can make suggestions for preventive maintenance services to customers, enhancing the quality of aftercare services.

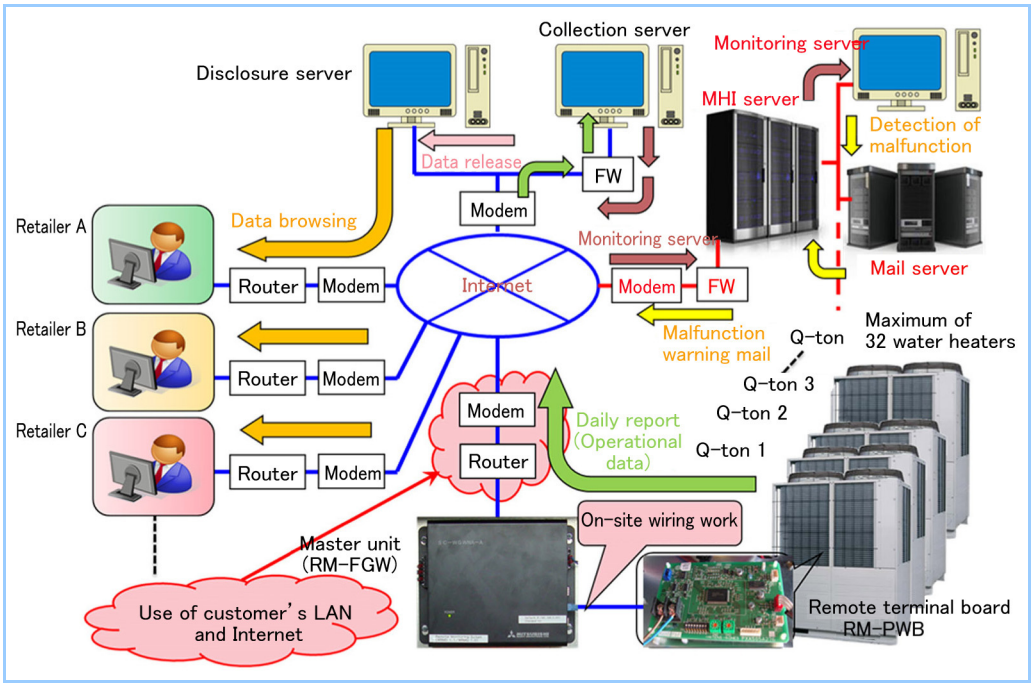


Figure 7 Schematic diagram of the remote monitoring system