2004 Prize of the Chairman of ECCJ

# Energy Conservation Activity Being Particular about Actual Data on Site: "Manufacturers' Common Sense v.s. My Common Sense"

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◎ **Keywords: Efficient operation of facilities**

## ◎ Outline of Theme

The Display factory in Takatana plant is fully equipped with state-of-the-art energy conservation utility facilities, in which air conditioning system, pure water manufacturing units, device cooling water unit, etc. are always operated by automatic control to maintain indoor conditions including cleanliness, temperature, and humidity that are essential for manufacturing and processing. These facilities are operated for 24 hours through year every day and consume a lot of energy, so reduction of $CO_2$ emission is required.
This plant has promoted "Operation 230" targeting reduction of overall energy by 30% in two years since FY2001. In the course of this energy conservation activity, we have promoted improvement activities in cooperation with manufacturers with the motto of actual data on site.. As a result, we have made significant progress, which is reported here.

## ◎ Implementation Period of the said Example

- Project Planning Period April first, 2001 – June 30th, 2001 Total 3 months
- Measures Implementation Period
  December first, 2001 – January 31st, 2002 Total 2 months
- Measures Effect Confirmation Period
  February first, 2002 – September 30th, 2002 Total 8 months

## ◎ Outline of Takatana Plant

- Items Produced Manufacturing of meters and displays for automobiles
- No. of Employees 2,828

- Energy cost

| | |
|---|---|
| Electricity (bought) | 66,678 MWh |
| City gas | 14,085 $Km^3$ |

## ◎ Outline of Target Facility (Overview of Utility Facility)

The Display Factory in Takatana Plant is equipped with special utility facility and supplies utilities including steam, cold water, air, gas, pure water, etc. to manufacturing plants. Pure water manufacturing units and device cooling unit that belong to this utility facility was the target of this energy conservation activity being particular about actual thing on site (Fig. 1).

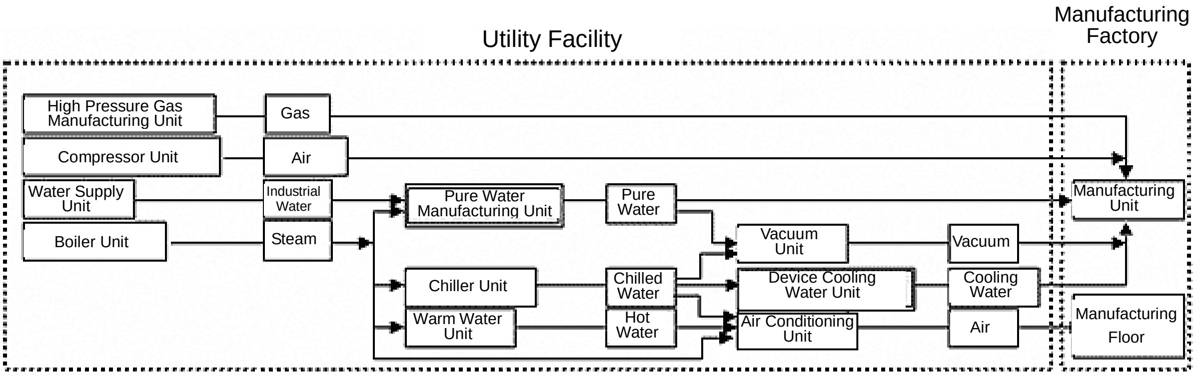



Fig. 1 Overview of Utility Facility

## 1. Reasons for Theme Selection

Breakdown of energy cost of Display Factory in FY2000 is shown in Fig. 2. Electricity for the utility facilities accounted for 50%. Compared to the factory target to reduce energy cost by 30% in two years, the reduction remained 20% although every effort was done for horizontal development of existing projects in our company, so we needed further reduction activities. To achieve even higher effect of improvement, the bold improvement measures from the view of actual data on site, compared to the specification recommendation values of facility manufacturers were required.

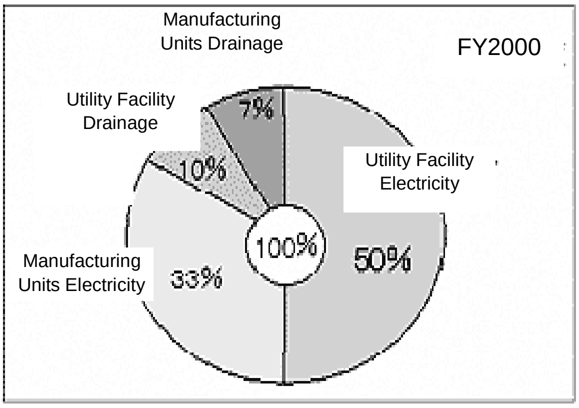



Fig. 2 Breakdown of Energy Cost

In this report, we show efforts based on actual data on site for pure water Reverse Osmosis(RO) unit and device cooling water unit, which gave us significant benefits among 41 energy conservation activities,.

## 2. Understanding of Current Situation

According to breakdown of electricity consumption by units at the end of fiscal year 2000, device cooling water unit accounted for 22% and pure water RO unit accounted for 15%. These two units represent 37% of the electricity consumption of the entire utility facility, but the number of energy conservation improvement activities remained only one for each. (Fig. 3)

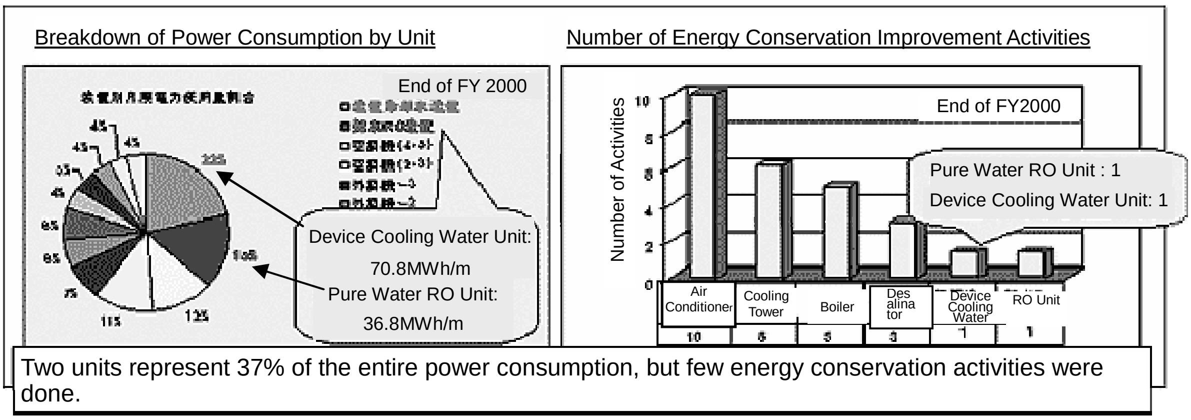



Fig. 3 Power Consumption by Unit and Number of Energy Conservation Activities

The reasons why there are few energy conservation activities are: pure water RO unit already has energy conserving specifications, there is a concern about impact on product quality, and modification is not allowed unless the manufacturer guarantees it.

For device cooling water unit, the reasons are that it is operated by linear control for energy conservation, improving its control method is difficult, and modification is not allowed unless the manufacturer guarantees it just as in the case of pure water RO unit.

However, because used amounts of pure water and cooling water are reduced due to energy conservation activities until the previous year, we thought we could break this situation if we persuade the manufacturer based on the actual data on site.

Overview of pure water RO unit and device cooling water unit that are the main cases of this report is shown here.

Pure water RO unit is the last process of primary pure water manufacturing units processes (Fig. 4), and composed of desalination tank, RO filter, primary CP, and pure water tank.

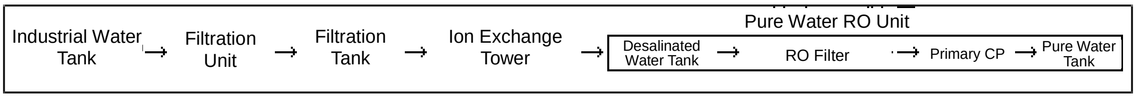



Fig. 4　Primary Pure Water Manufacturing Units Process Chart

This pure water RO unit is a unit that manufactures pure water for cleansing foreign matters of several micrometers that adhere to glass panels as products. (Fig. 5)

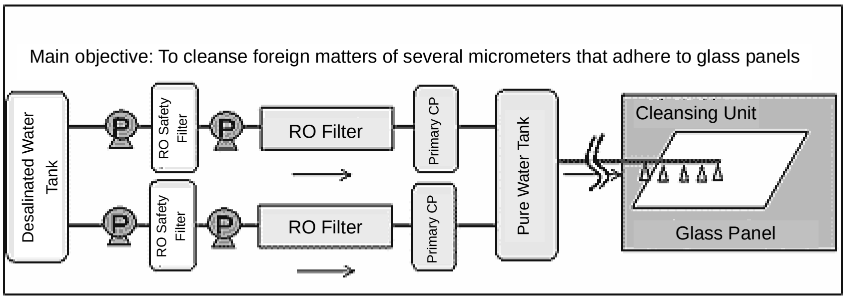



Fig. 5 Pure Water RO Unit Overview Chart

Device cooling water unit always circulates cooling water (20℃) by alternatively operating two 132 kW linear pumps to cool the hot part of the manufacturing units. (Fig. 6)

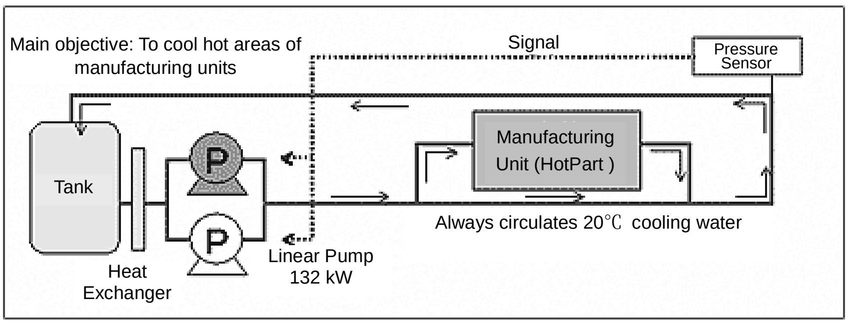
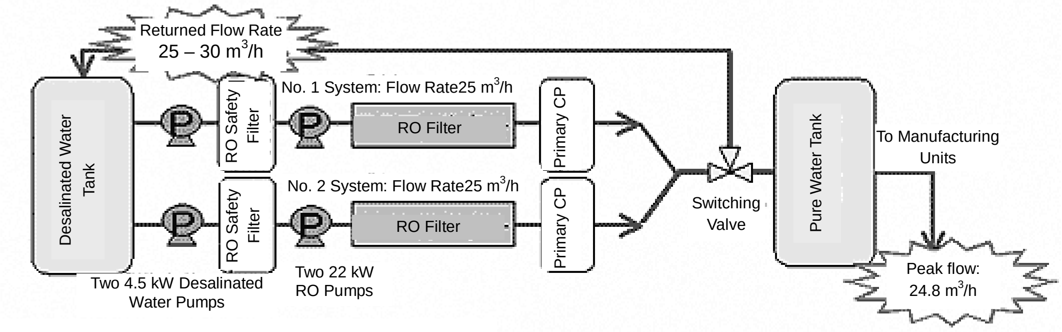



Fig. 6 Device Cooling Water Unit Overview Chart

Investigation of the manufacturing capacity of the pure water RO unit and used amount by manufacturing units revealed that used flow rate has decreased due to water conservation activities of manufacturing units (optimization of flow rate during cleansing and waiting) and current peak flow rate on the manufacturing units from the view point of actual data on site is 24.8 $m^3$ while the pure water manufacturing capacity is 50 $m^3$ and 25-30 $m^3$ is returned to the desalination tank, which means one system of pure water unit is enough. (Fig. 7)




<u>Result of Survey Based on Actual Place and Stuff</u>

Pure Water RO Unit
- Two systems manufacture 50 $m^3/h$ pure water, of which 24.8 $m^3/h$ goes to manufacturing units and 25-30 $m^3/h$ returns to the desalinated water tank.

Manufacturing Units
- Due to drainage volume reduction activity for the product cleansing process, which was enforced in March, 2001, pure water manufactured by one system became excessive.

Hearing to Person-in-charge
- It was known that returned flow rate changes due to change in used amount by the manufacturing units.

Fig. 7 Investigation of Pure Water RO Unit

For the device cooling water unit, used amount has decreased due to reduction activities of cooling water in the manufacturing units (elimination and consolidation of facilities and consolidation of piping) and the current flow rate of cooling water is average 1500 L/min and 1830 L/min at peak while maximum capacity of water supply is 5000 L/min and the pumps are operated at the lowest level. (Fig. 8)

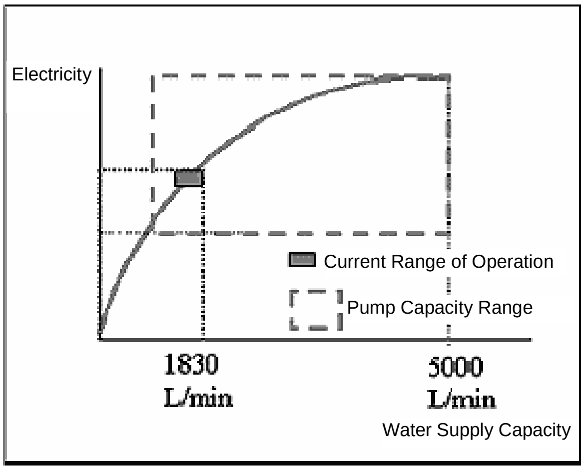



Fig. 8 Pump Capacity and Operation Range

# 3. Progress of Activities

## (1) Implementation Structure

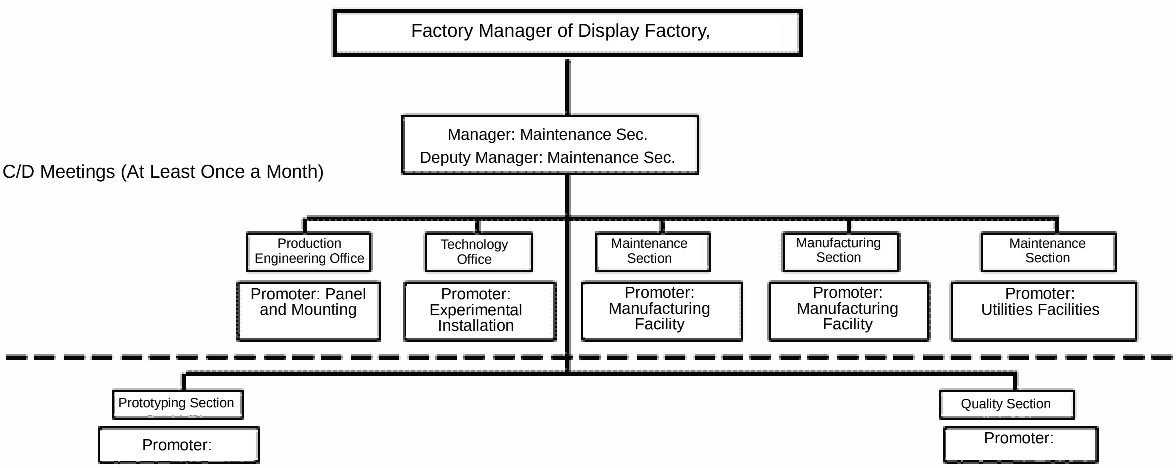



Fig. 9 Organization of 230 Activity

## (2) Target

Reduction of electricity consumption by the utility facility by 30% in two years

## (3) Problems and their Investigation

### 1) Problems common among facilities

- Pure water RO unit and device cooling water unit are important facilities and modification is not permitted unless their performance cannot be guaranteed. Therefore, it is necessary to cooperate with the manufacturer in the energy conservation modification and then to obtain facility guarantee afterward by the manufacturer.

**2) Problems of each unit**

- For pure water RO unit, use of pure water decreased due to effect of water conservation activities on the manufacturing unit. Therefore, we want to stop one system, but the manufacturer maintained continuous operation of two units considering emergency care because stopping one unit may cause bacterial growth and low specific resistance of accumulated water. We investigate this for energy conservation activities.
- For device cooling water unit, use of cooling water decreased due to effect of water conservation activities on the manufacturing units. Therefore, we want to downscale the unit, but the manufacturer is concerned about future troubles and maintained proposing specifications with larger safety factor that can be guaranteed. We investigated this for downscaling.

## 4. Details of Measures

### (1) Measures for RO Unit

Review of measures by “manufacturers’ common sense” v.s. “my common sense (actual data on site)"

The manufacturer maintained that stopping one system will cause bacteria growth and deterioration of RO filters, and said replacing filters requires several million yen. Further more, they contended that the specific resistance of accumulated water may become lower than the value of standard, so they cannot guarantee.

Based on "my common sense (actual data on site)”,

1) We have data that shows the fact that no bacteria was detected by water quality inspection after operation had been stopped for 24 hours assuming power outage in legal inspection.
2) The specific resistance of the pure water when the unit is restarted after shutdown is slightly lower than before shutdown due to accumulated water, but it is well within the standard and recovers as time elapses. By draining this accumulated water, recover of specific resistance can be accelerated.

Base on these, we determined that one system can be stopped within the range of limited conditions.

Some people thought it was risky, but we did not hesitate to negotiate with the manufacturer and won consent to perform alternative operation test including the condition to stop operation for limited period of time for 90 days, and we decided to shape improvement activity based on the results of water quality inspections before and after the test.

As a result, the water quality inspections before and after the alternative operation test showed no problem of bacteria growth and specific resistance, so we obtained consent of the manufacturer to stop operation of one unit for less than 24 hours. (Fig. 10)

| | Manufacturer's Common Sense | My common sense (Actual data on site ) |
|---|---|---|
| Alternative Operation of One Unit | Continuous operation of two unitsis basic assumption. | Stopping one unit is possible. |
| | Bacteria may become proliferous. | After 24 hours of shutdown, bacteria does not become proliferous. |
| | Deterioration of RO filter | Daily inspection does not detect any change in differential pressure of the filter. |
| | Water quality cannot be guaranteed. | Verified by alternative operation test. |

Based on the 90-day alternative operation test, we obtained consent of the manufacturer.

Fig. 10 Investigation of Stopping One Unit

Major modifications were to add 24-hour timer to the control panel of the pure water RO units and to change the program so that alternative operation of each unit and the operation of both units in emergency are available. For drain process of the accumulated water, the manufacturer proposed to add contact-point output flow meter and motor valves to drain the water to rain water. In contrast, we proposed to utilize existing motor valves and change software only to return accumulated water to the desalination tank for reuse. This reduced the construction cost by 80%. (Fig. 11)

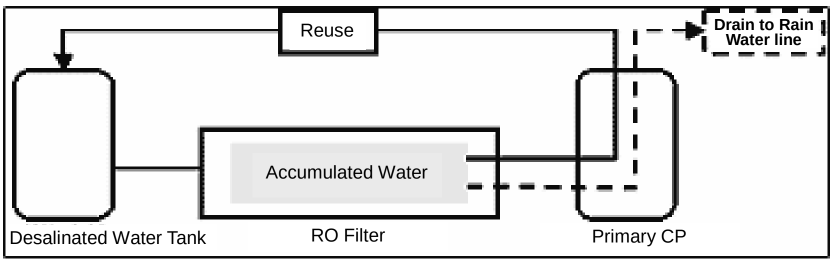



Fig. 11 Processing of Accumulated Water

## (2) Measures for Device Cooling Water Unit

Review of measures by "manufacturers' common sense" v.s. "my common sense (actual data on site)"

For the pump capacity and current situation, as shown in Fig. 12, the water feed pressure is 0.20 Mpa in the user side of the manufacturing units on the fourth floor while the pressure supplied to the manufacturing units is almost same as 0.22 MPa, so the pump head cannot be changed. For feeding rate, however, flow rate supplied to the manufacturing units was decreased to 1500 L/min on average due to water conservation activities for the manufacturing units, so downsizing of the pump while keeping the head is essential to conserve energy.

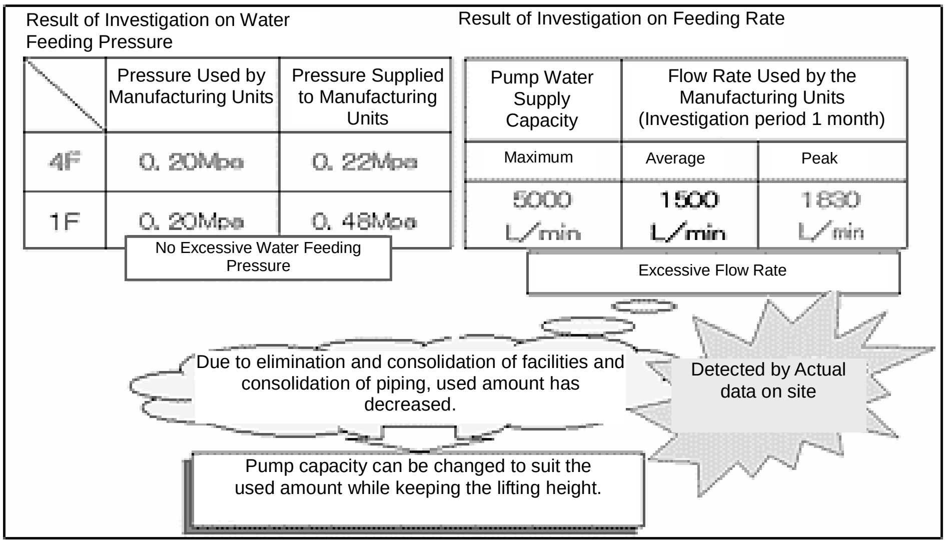



Fig. 12 Pump Capacity and Current Situation

Although we presented data based on actual data on site, " manufacturers' common sense" was to guarantee the electric motor drive with higher class water feed capacity considering addition of manufacturing units. (Electric motor drive 75 KW, safety factor 1.8, water feed rate 3300 L/min)

We thought safety factor can be 1.2 of the required specifications based on "my common sense". Therefore, we proposed to operate existing spare machine in the event of increase in production and to show management of load by a monitoring system and we agreed on pumps smaller than those proposed by the manufacturer (Electric motor drive 55 KW, safety factor 1.2, water feed rate 2200 L/min). (Fig. 13)

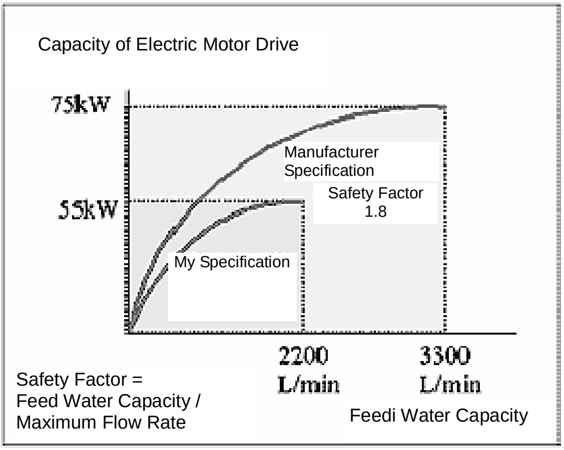



Fig. 13 Comparison of My Specifications and Manufacturer Specifications

Major alterations were electric motor drives, antivibration mount, linear pump and flanges, and improvement to smaller pump unit that is suitable for the current flow rate was realized. (Fig. 14)

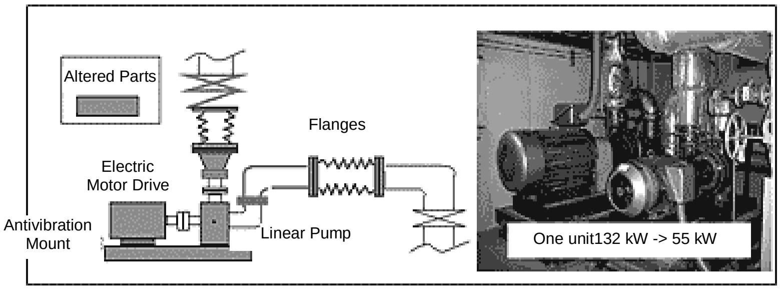



Fig. 14 Altered Parts of Linear Pump Unit

For ancillary works, while the manufacturer proposed installing new control panel, we focused on reduction of ¥ cost. We consolidated unused space within the existing control panel to install new parts and connected with each part by short wiring. As a result, we achieved cost reduction of 82%.

# 5. Effects achieved after Implementing Measures

## (1) Actual Performance of the 2 Cases

| Unit Name | Monetary Amount of Improvement | Amount of Conserved Electricity | Reduced $CO_2$ emission | Pat back time |
|---|---|---|---|---|
| Pure Water RO Unit | 1,070,000 yen | 197 MWh/year | 20 t-c/year | 0.3 years |
| Device Cooling Water Unit | 9,400,000 yen | 384 MWh/year | 40 t-c/year | 1.5 years |

### (2) Actual Performance of the 230 Activity

1) Compared to the target to reduce electricity of the utility facilities by 30% within two years, we achieved 32% reduction.
2) We realized total 41 improvement projects in FY2002. Monetary amount of energy conservation effect was 28,389,000 yen/year and $CO_2$ emission was reduced 179 t-c/year.

## 6. Summary

(1) We now strongly feel it is important to see the actual data on site, to confirm the facts, to eliminate bias to discover truth behind facts, and to determine specifications of energy conservation activity to enforce good improvement.
(2) As a result of pursuing seemingly natural word "common sense", we visualized energy conservation specifications that were not visible before and strengthen bases of energy conservation activities of myself and coaching my subordinates.
(3) Realizing improvement that seemed impossible gave us great confidence and now we want to promote further energy conservation as challenges for a leap forward of ourselves.

## 7. Future Plan

We plan to develop these efforts to energy conservation of manufacturing units.