2005 Prize of Director General of Regional Bureau of Economy, Trade and Industry

Grassroots Activities of Electric Power Conservation for Metal Rolling

Kobe Steel, Ltd., Kobe Works
Facility Maintenance Department
Facility Maintenance Section, Instrumentation Maintenance Team
Combined QC Circle of Metal Rolling and Facility Maintenance Sections

◎ **Keywords: Rationalization of conversion to electromotive power and heat (Electromotive power application facilities, electrothermal facilities, etc.)**

◎ Outline of Theme

A decision was made to implement energy conservation activities (SAVE activities) throughout the Kobe Steel Works, starting from April 2002. Activities for promotion of energy conservation were also launched at the three factories (No. 3 Blooming Mill, Steel Bar Factory and No. 7 Wiring Material Factory) of the Metal Rolling Zone, where we work.
Energy conservation activities were vigorously promoted a number of times in the past, but no fundamental solutions were ever found to deal with the issue of electric power. It was therefore necessary for us to do away with the conventional stereo typical concepts and to promote electric power conservation activities in an effort to bring about an ultimate eradication of wasteful electric power use. It was possible, as a result, for us to make a substantial reduction in consumption of electric power.

◎ Implementation Period of the said Example

- Period Planning Period: April 2002 through October 2002 (Total of 7 months).
- Measures Implementation Period: October 2002 through August 2003 (Total of 11 months).
- Measures Effect Verification Period: August 2003 through March 2004 (Total of 8 months).

◎ Outline of the Business Establishment

- Production items: Steel products (wiring materials and steel bars).
- Number of employees: 1,300 persons (as of April 1, 2004).

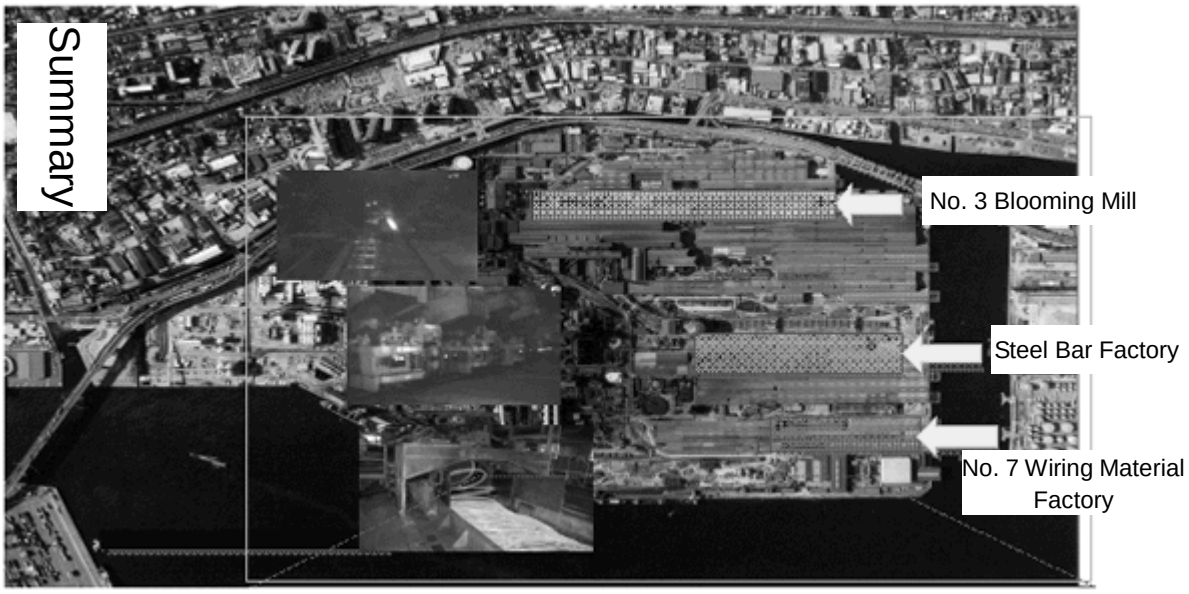
- Annual energy consumption (record for FY2004):

  Coal and coke: 860,000 tons

  Utility supplied gas: 75,300,000 Nm^3

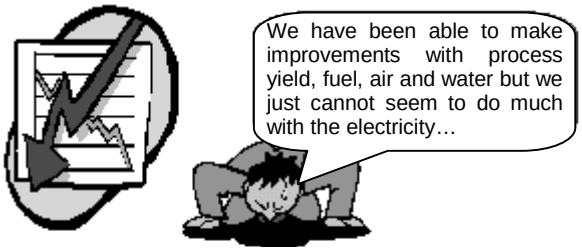
◎ Overview of Target Facilities

The three metal rolling factories are positioned in the final process of steel production processes at the Kobe Works, where metal rolling production takes place, taking in bloom manufactured at the steel mill is made into rolling stock (billet) and then processing it to create the final finished rolled metal.



1. Reasons for Theme Selection

A decision was made to implement energy conservation activities (SAVE activities) throughout the Kobe Steel Works, starting from April 2002. Activities for promotion of energy conservation were also launched at our metal rolling mill, where we work, as the “Chiriyama Campaign” (mountain of dust campaign), which was vigorously promoted as a thorough grassroots energy conserving program. Although it was possible to make improvements in terms of process yield and utility, it was not possible to make any significant reduction of electric power. The “Chiriyama” team therefore sent out their “SOS” call, which resulted in the matter to be taken up by this project as a challenge.



"SOS" call for help from the Chiriyama Campaign at the metal rolling mill

* "Chiriyama": An abbreviation for the old saying in Japan, "Chiri-mo Tsumore-ba Yama-ni naru" (or "enough dust builds a mountain", or many drops make a flood).

2. Understanding and Analysis of Current Situation

An investigation of energy consumption at the three metal rolling factories revealed that the electric power consumption was the only factor that was not in a downward trend (Figure 1). Electric power consumed at the three metal rolling factories corresponded to the amount of production that take place (Figure 2), with the amount equaling about 20,000 average households. We therefore considered there would be some waste that can be addressed.

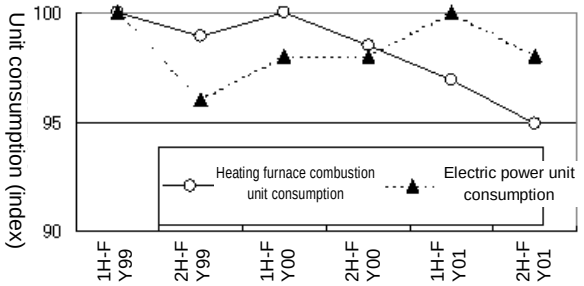


Figure 1: Breakdown of energy consumed at the three factories

* Values in the graph are indices with the figure from the first half of FY1999 set as 100.

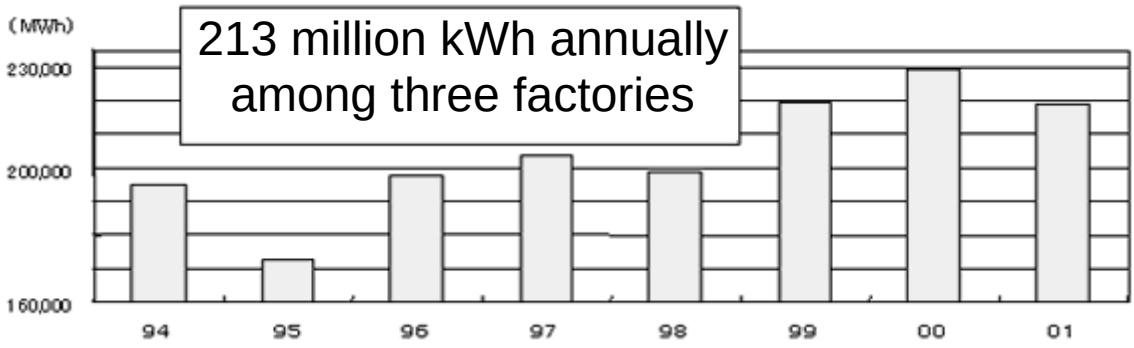


Figure 2: Electric power consumption of the three factories

When the "electric power" was investigated for each individual factory of the three factories in the Metal Rolling Zone, it was revealed that the electric power consumption at the No. 7

Wiring Material Factory was in an increasing trend year after year, while it has flattened out at the Steel Bar Factory and it was in an improving trend at the No. 3 Blooming Mill, due to the improvement case examples implemented in the past, but the electric power consumption unit has been flattened out for several years, which implied that there was still some room for improvement.

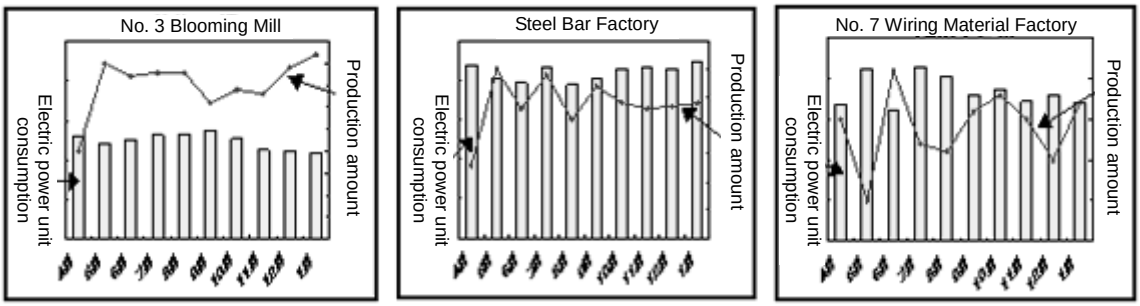


Figure 3: Investigation into electric power consumption by individual facilities

3. Progress of Activities

(1) Implementation Structure for Promoting Improvement Activities

Activity organizations and activity schedules were defined as shown in Figure 4 and Table 1 below. The three factories in whole were taking part in improvement activities as a group for reducing electric power consumptions.

Organization chart to promote group activities

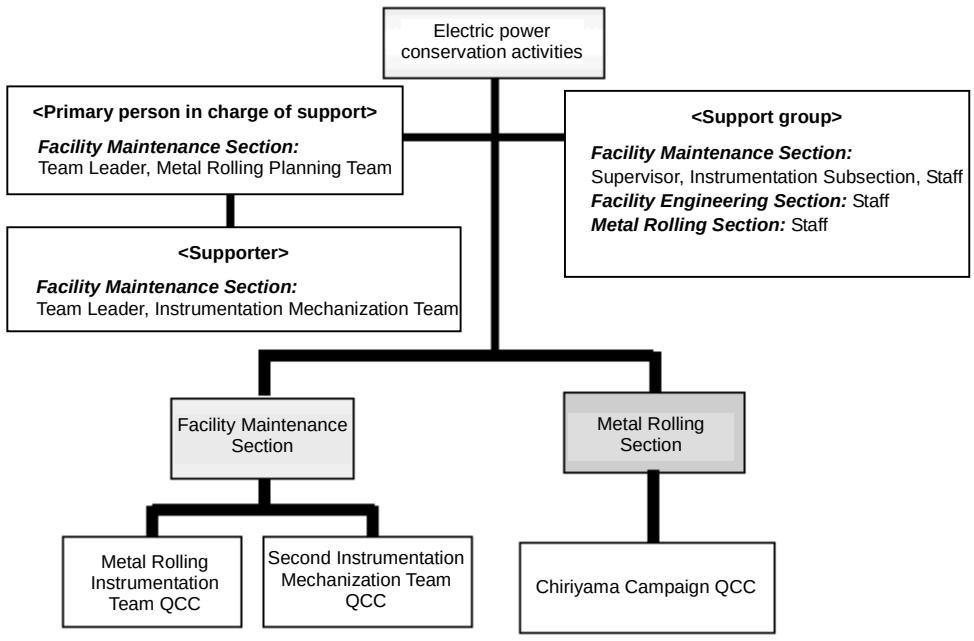
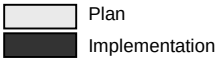


Figure 4: Organizations for improvement activities

Table 1: Schedule of improvement activities



Implementation item	Primary person in charge	Aspects of step	Period				
			April 2002	October 2002	April 2003	October 2003	April 2004
Understanding current status	Metal Rolling Planning Team QCC	Interpretation by principle of three physical evidences, based on data.					
Setting targets	Instrumentation Mechanization Team QCC	Set targets as high as possible.					
Analyzing factors	Metal Rolling Section Chiriyama	Repeat asking why, without getting caught up in conventional patterns.					
Considering and implementing strategies	Steel Bar Instrumentation Team QCC	Cheaply, quickly and simply.					
Verifying effects	Instrumentation Mechanization Team QCC	Verification of each strategy for each line.					
Standardization and rooting of management	No. 3 Blooming Mill Instrumentation Team QCC	Implementation of rooting and follow-ups.					
Reflection and summary	No. 7 Wiring Mill Material Systems Team QCC	Horizontal implementation period for next set of themes.					

(2) Target Settings

To reduce the electric power consumption at the three metal rolling factories by 1 % (2.13 million kWh per year) by the end of January 2004.

(3) Problem Points and their Investigation

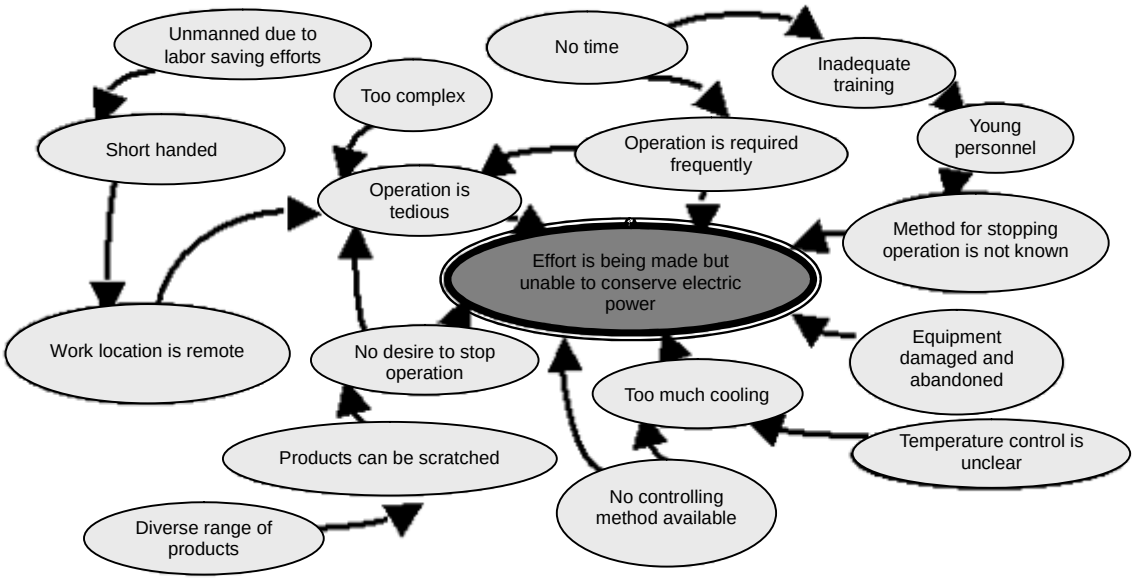
Factors that were contributing to the inability to attain electric power conservation were considered by all members of circles at each individual corporate organization. Problems were discovered by reviewing association diagrams, among which the following three critical factors were selected for consideration:

[1] Are there facilities that, according to the Energy Management Standard, consume large amount of electric power?

[2] Are there facilities that are idly operating metal rollers?

[3] Are there electrical equipment, for which output can be limited, depending on operating status?

Analysis of factors (association diagram method)



1) Factorial analysis [1] “Are there facilities that, according to the Energy Management Standard, consume large amount of electric power?” 2,875 units of facility equipment were reviewed.

Facilities that consume large amount of electric power according to the Energy Management Standard are:

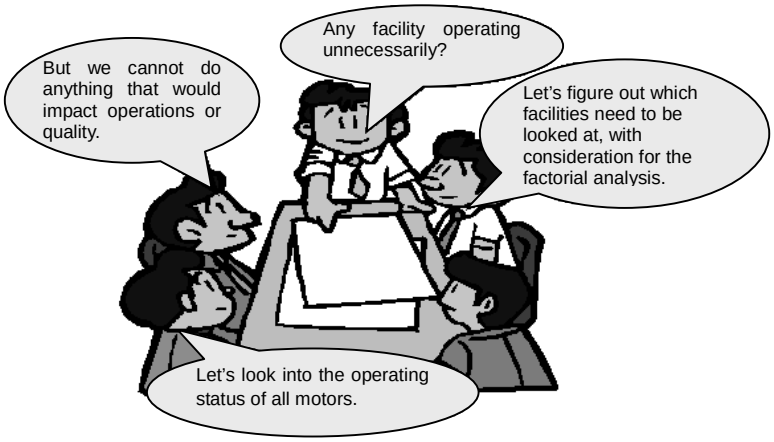
1. Pumps

2. Blower fans

3. Rolling machines

4. Roller tables

Three metal rolling factories:
Review of 2,875 units of motors.



2) Factorial analysis [2] "Are there facilities that are idly operating metal rollers?" Following reviews were conducted.

Understanding of metal roller status (review of motors):

(1) Those with larger electric power consumption.

(2) Those that are operated continuously.

(3) Those that are only operated manually.

1. Investigation into wasteful operations:

[1] Equipment operating even though no metal is being rolled.

[2] Equipment operating at full speed at all times.

[3] Equipment being excessively cooled.

[4] Equipment remains in operation when operation can be suspended.

[5] Thinned out operation is not conducted, even though there are many equipment.

[6] Equipment can be operated intermittently, but are not.

[7] Specifications of equipment are excessive.

⇩

Narrowed down to 39 units.

2. Investigation into operating status:

[1] Taking measurement of electric current for operations.

Measurements for electric current and operating time of the 39 units of motors were taken.

⇩

Narrowed down to 6 units.

Based on these investigation results, we narrowed down our focus on the following six facilities, which were considered candidates for improvements.
Summary of findings was made for following two major items:

Facilities for which it may be possible to limit output:

-No. 3 Blooming Mill: Hot scarf high pressure water pump.

-No. 3 Blooming Mill: Heating furnace combustion blower.

-Steel Bar Factory: Cold bed and rectifier type direct current motor cooling fan.

Facilities for which it may be possible to suspend operation, depending on metal rolling status:

-Steel Bar Factory: Spooling machine underground pit fan

-No. 7 Wiring Material Factory: Spooling machine line motor cooling fan.

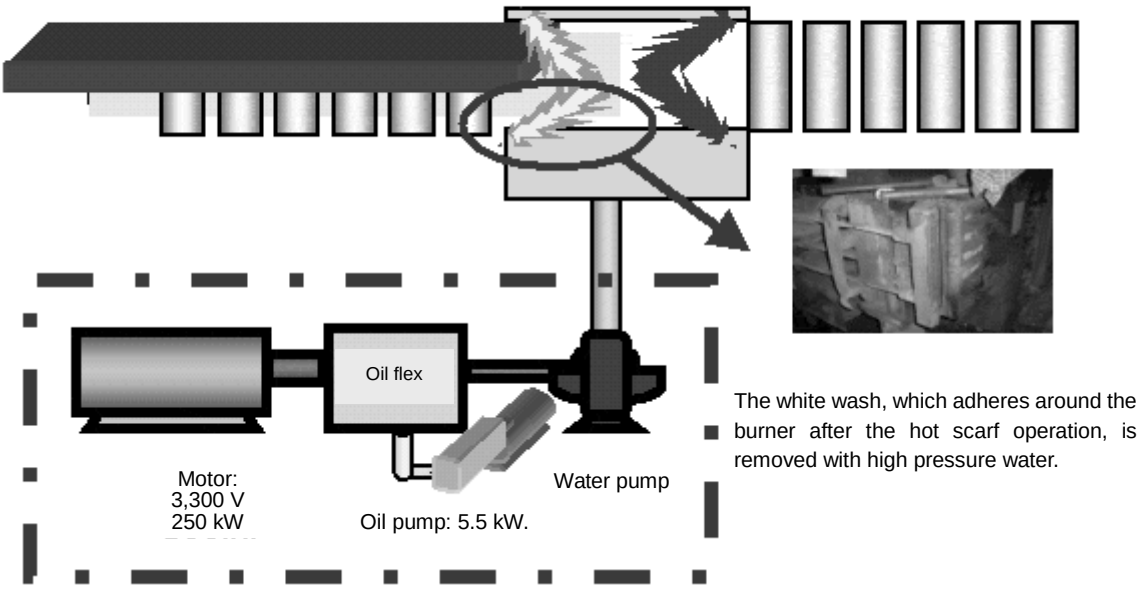
-No. 7 Wiring Material Factory: VBM metal roller.

3) Evaluation [3] “Are there electrical equipment, for which output can be limited, depending on operating status?”:
Motors for which it may be possible to limit output:
(1) No. 3 Blooming Mill: Hot scarf high pressure water pump.
(2) No. 3 Blooming Mill: Heating furnace combustion blower.
(3) Steel Bar Factory: Cold bed and rectifier type direct current motor cooling fan.

Of the three facilities mentioned above, a description of the hot scarf high pressure water pump at the No. 3 Blooming Mill will be provided. The hot scarf is a facility for dissolving flaws that form on the surface of bloom, by using oxygen and propane. The white wash, which is generated as a result, is removed using high pressure water. This high pressure water pump for removing white wash is in operation continuously at full power, but when the hot scarf is not in use, the power level can be lowered.

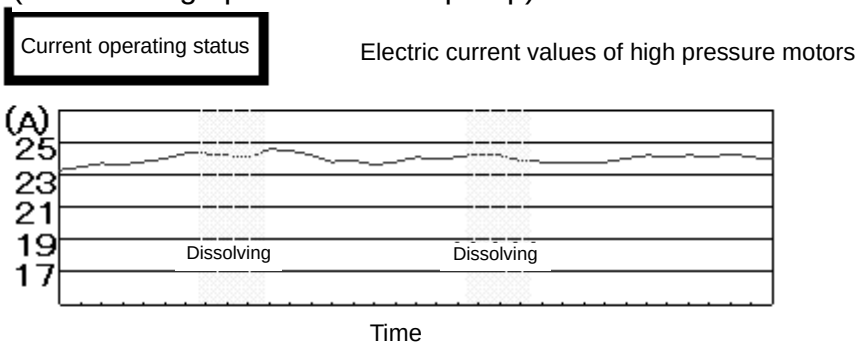
Verification
(motors for which it may be possible to limit output)

Hot scarf high pressure water pump



The output is 100 % when the hot scarf is in operation, while rotation of the motor is lowered to 1000 rpm using oil flex when the hot scarf is not in use. Furthermore, the electric current is flowing at 24 A continuously, whether or not the hot scarf is in use, resulting in a major consumption of electric power at all times.
It is therefore potentially possible to conserve energy for this facility during the time when the hot scarf is not in use, if an inverter conversion can be implemented.

Verification
(hot scarf high pressure water pump)



Electric current value is around 24 A at all times.

Electric power consumption is maximum at all times.

“Motors for which it may be possible to suspend operation, depending on metal rolling status”:

(1) Steel Bar Factory: Spooling machine underground pit fan.

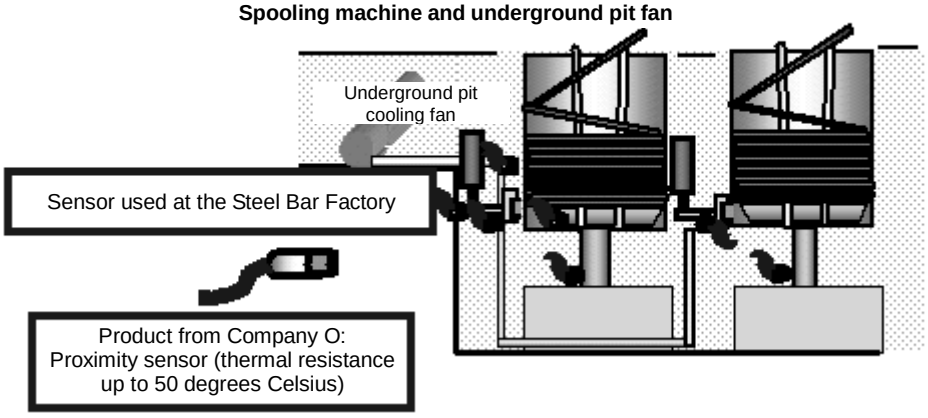
(2) No. 7 Wiring Material Factory: Spooling machine line motor cooling fan.

(3) No. 7 Wiring Material Factory: VBM metal roller.

Three facilities were mentioned, but upon verifying the spooling machine underground pit fan at the Steel Bar Factory, it was determined that cooling was excessive. Due to this reason, conditions were reviewed and it was discovered that it was possible to conserve electric power used for fan motor by changing circuitry.

Verification
(facilities for which it may be possible to suspend operation, depending on metal rolling status)

Spooling machine and underground pit fan



4. Review and Discussions on Measures

Strategies for “limiting output”:

1) Respective strategies were implemented, as shown in Figure 10.

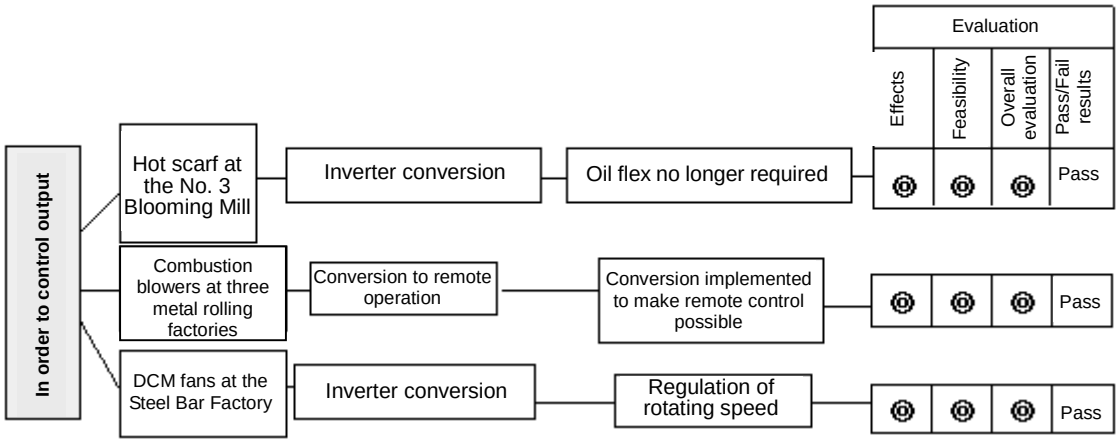


Figure 10: Schematic diagram of strategy implementations for reduction of electric power consumptions

2) Respective strategies were considered and implemented, as shown in Figure 11.

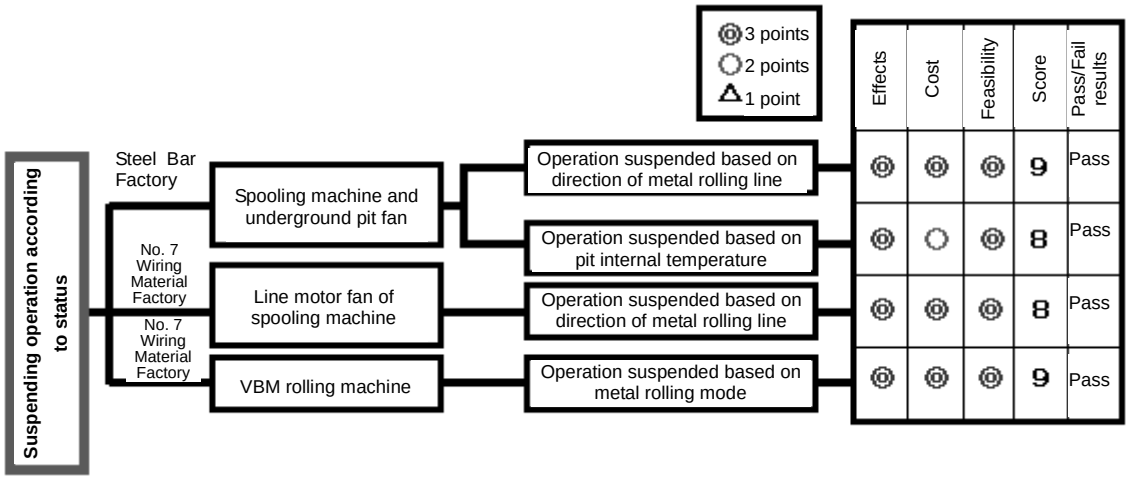
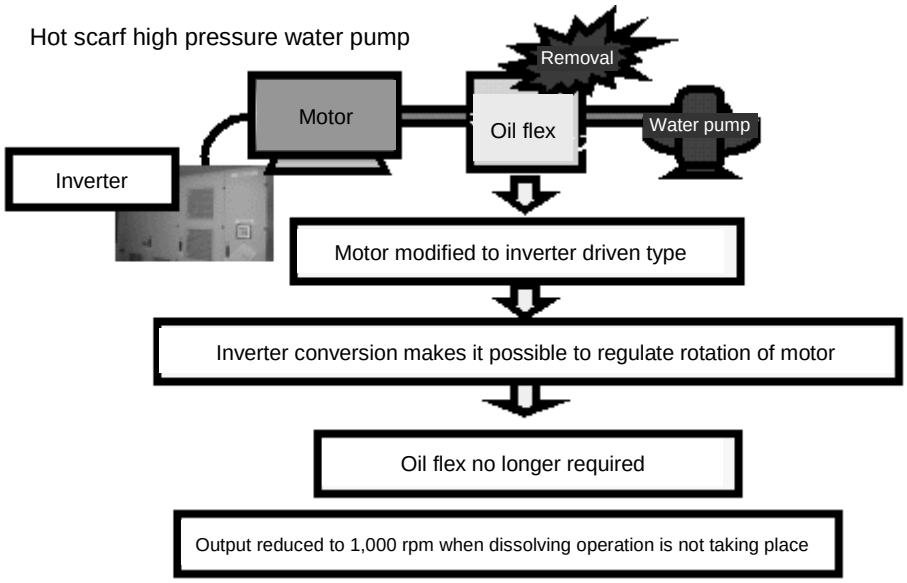


Figure 11: Schematic diagram of strategy implementations for suspending operation of facilities based on metal rolling status

5. Details of Measures

Strategy 1:

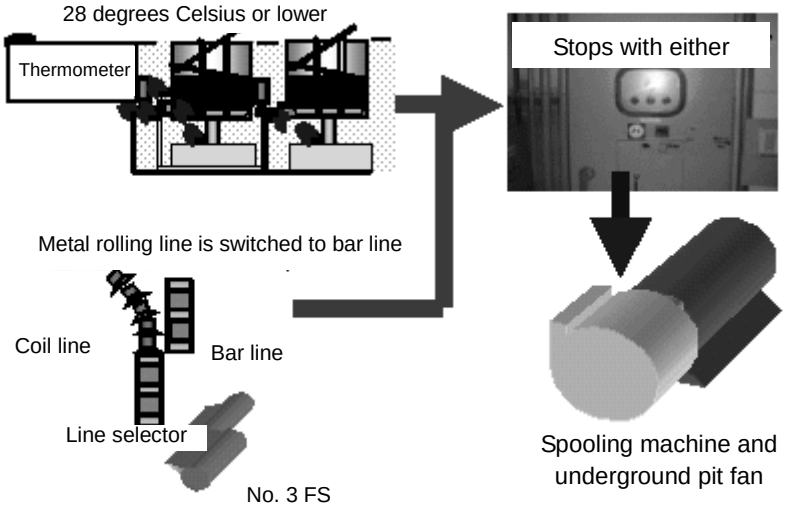
The hot scarf water pump was converted into inverter type for operation at 1,800 rpm when in use and the output was reduced to 1,000 rpm when the hot scarf is not in use for dissolving.



Strategy 2:

Suspension of operation, depending on metal rolling status:

The spooling machine underground pit fan was being cooled excessively, so a thermometer was installed to trigger a stop signal when the temperature dips below 28 degrees Celsius. Furthermore, a circuit was created to stop operation unconditionally when the metal rolling line is switched to the bar line, in order to reduce wasteful use of electric power.



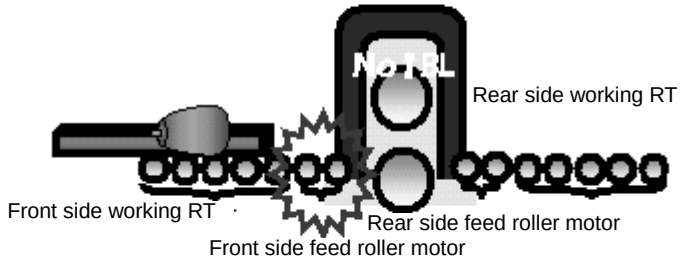
Strategy 3:

Unexpected energy conservation discovery made due to bloom feed roller malfunction

A feed roller had an electrical malfunction at the No. 3 Blooming Mill one day and caused suspension of metal rolling operation.

A member of the activity circle suggested that the continuous metal bar material was ten meters in length and it would be possible to simply roll it the way it was. Based on this conclusion, metal rolling operation was restarted and metal rolling was performed without any adverse effects on the product.

No. 1 BL feed roller at the No. 3 Blooming Mill is malfunctioning.



Formulation of strategy 3:

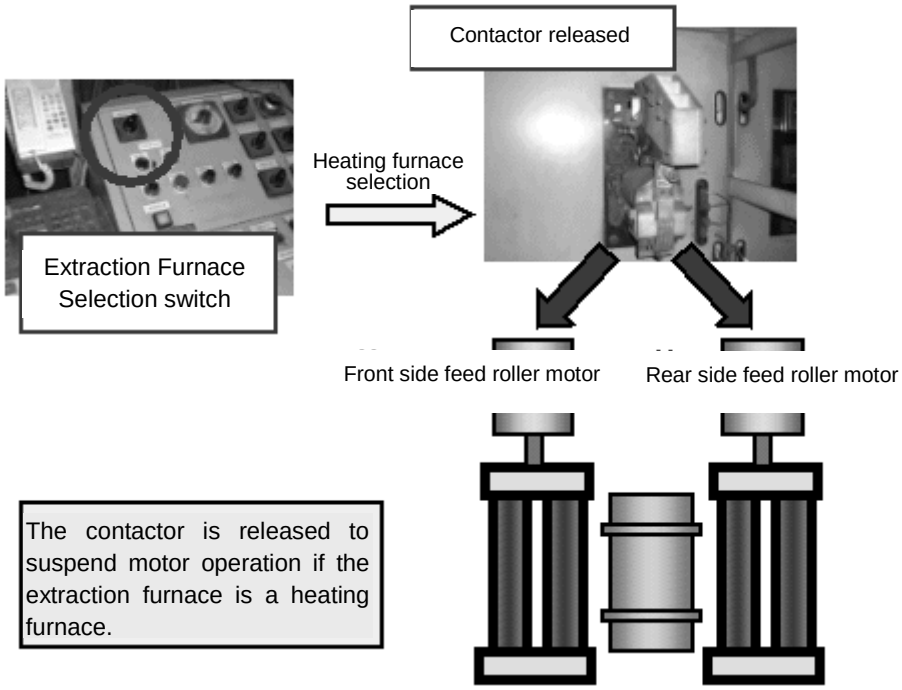
The circuit that stops the feed roller was modified.

What can we do? Is there anything we can do?

How do we avoid total suspension of operations?

Conclusion:

A circuit was installed to stop the feed roller while the “Extraction Furnace Selection” switch is turned over to the heating furnace, to stop the feed roller for the purpose of conserving energy.



Summary of results and understanding effects

Following strategies were implemented in order to reduce wasted electric power by limiting output:

(1) Conservation of electric power through inverter conversion of hot scarf high pressure water pump at the No. 3 Blooming Mill.

(2) Energy conservation through single unit operation of heating furnace combustion blower at the No. 3 Blooming Mill.

(3) Energy conservation through inverter conversion of DCM cooling motor at the Steel Bar Factory.

These three strategies were successfully completed.

Furthermore, for the purpose of reducing energy consumption, operation of facilities are suspended, depending on the metal rolling status:

(1) Electric power reduction with spooling machine underground pit fan at the Steel Bar Factory.

(2) Electric power reduction with spooling machine line motor cooling fan at the No. 7 Wiring Material Factory.

(3) Electric power reduction with VBM metal roller at the No. 7 Wiring Material Factory.

These three strategies were successfully completed.

Furthermore, as unanticipated effect:

(1) Electric power reduction by suspending operation of feed roller at the No. 3 Wiring Material Factory.

We were able to conserve electric power by successfully completing seven strategies.

6. Verification of Effects Achieved after Implementing Measures

We were able to achieve electric power reduction by 3.2 million kWh per year and cleared the target of 2.13 million kWh per year, by successfully implementing these seven strategies.

The annual monetary value of effects was JPY18 million.

Furthermore, the reduction of electric power consumption by 3.2 million kWh per year resulted in the reduction of carbon dioxide emission by 1,411 tons per year.

Energy conservation effects

[1] Inverter conversion of hot scarf high pressure water pump at the No. 3 Blooming Mill ➡ 0.98 million kWh.

[2] Suspending operation of No1BL feed RT at the No. 3 Blooming Hill when 3CC material roller is in operation ➡ 0.39 million kWh.

[3] Single unit operation of heating furnace combustion blower at the No. 3 Blooming Mill ➡ 0.82 million kWh.

[4] Inverter conversion of cold bed and rectifier type direct current motor cooling fan at the Steel Bar Factory ➡ 0.2 million kWh.

[5] Automated operation of spooling machine underground pit fan at the Steel Bar Factory ➡ 0.1 million kWh.

[6] Automated operation suspension of spooling machine line motor cooling fan at the No. 7 Wiring Material Factory ➡ 0.22 million kWh.

[7] Suspended operation of motor at the No. 7 Wiring Material Factory when the VBM metal roller is in the Slur mode ➡ 0.49 million kWh.

Annual energy conservation amount: 3.2 million kWh

Monetary value of energy conservation effects

Annual monetary value of effects: JPY18 million per year.

7. Summary

We believe that we were successful in our electric power and energy conservation activities, which we had attempted numerous times in the past but failed, because all the members focused on the three factories in the Metal Rolling Zone with earnest feeling. We are sure that this success was made possible through combined effort of all members.

8. Future Plans

We are prepared to make our commitment to relentlessly strive on with our energy conservation activities and continuing to face further challenges for the steel mill lines, which will be required to increase the effort for reducing carbon dioxide emissions as a part of strategies against global warming.