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Outline of Advanced Total Information System for Cold Rolling at Mizushima Works

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We refreshed total information system on cold rolling at Mizushima Works in Jan. 1984. This system is aimed at: (1) Development of a system to control planning of production. (2) Automatically gathering of data by process computer and sensors at all processes in cold rolling work and construction of database to manage and analyze quality and operation. (3) Realizing of an optimum lot of products. (4) Adoption of the information system in the Japanese language. (5) Realization of large-scale computer networks by a new system technique, and so on. This system runs smoothly, and brought much benefit in shortening the payment term, improvement in quality and productivity, cost saving, and so on, by upgrading the product control level, converting of quality assurance system, smoothing of material handling, realizing of optimum lot of products, efficient work, and so on, in the manufacture of products with small lots and great varieties and higher products.

The body can be viewed from the next page.

Outline of Advanced Total Information System for Cold Rolling at Mizushima Works*


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We refreshed total information system on cold rolling at Mizushima Works in Jan. 1984. This system is aimed at:

(1) Development of a system to control planning of production.

(2) Automatical gathering of data by process computer and sensors at all processes in cold rolling work, and construction of data base to manage and analyze quality and operation.

(3) Realizing of an optimum lot of products.

(4) Adoption of the information system in the Japanese language.

(5) Realization of large-scale computer networks by a new system technique, and so on.

This system runs smoothly, and has brought much benefit in shortening the payment term, improvement in quality and productivity, cost saving, and so on, by upgrading the product control level, concreting of quality assurance system, smoothing of material handling, realizing of optimum lot of products, efficient work, and so on, in the manufacture of products with small lots and great varieties and higher products.

1 Introduction

The total information system for cold rolling at Mizushima Works centers around the system for controlling production planning. The system began operation simultaneously with the commissioning of the cold rolling mill in 1969.[1] Although several programs to upgrade the performance levels have since been instituted, drastic measures have become necessary to deal with such problems as (1) the limitations of the conventional online computer (O/C), (2) the limitations in flexibility and expandability of the system, which was constructed in a conventional business environment, and (3) the fact that its merit as an optimization measure is inevitably localized.

Since the oil crisis in 1973, business climates have greatly changed, and Mizushima Works has instituted several wide-scale rationalization plans, such as the synchronization of upstream and downstream processes and the continuation and automation of operations in various processes. Further, to cope with the diversification of user needs, the Works has striven to enhance the quality of products through a multi-kind, small lot production and an integrated operation control. Consequently, construction of a consolidated system capable of coping with these new conditions has been urgently required by all the sectors concerned.

As part of the construction of the total information system for production and control at Mizushima Works,

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the development of an advanced total information system for cold rolling has been in progress since 1981. Aims included the expansion of the system and improvement of its capacities, and renovation of the O/C and development of new O/C functions. Conversion to this advanced total information system for cold rolling was completed in January 1984, and the new system is now working smoothly. In the following, the new system for cold rolling is outlined.

2 Aims of New System

As mentioned above, the object of the development of the new system is the renovation of the existing system, with the main points outlined below:

(1) Development of Plan-oriented Production Process Control System
To cope with the synchronization and continuation of processes by developing a production process control system realizing increased systematic planning and shortening the lead time from order acceptance to product shipment by enhancing the accuracy of production schedule control.

(2) Reinforcement of Quality Assurance System
To introduce process computers and sensors in the manufacture of multi-kind, small-lot, high-value-added products and to eliminate operational errors in automatic collection of quality and operation data and automatic presetting of quality-oriented control items. To introduce state-of-the-art system techniques such as Japanese-language terminals, thereby improving operational efficiency.
Further, to construct a data base to manage and analyze quality and operation, thereby enhancing efficiency in analysing work.
To impart to products sophisticated quality through the above-mentioned measures, thereby achieving quality enhancement and operational stability, and to direct staff jobs toward the development of new techniques and products with the help of increased efficiency in executing the jobs.

(3) Facilitation of Material Flow and Optimization of Production Lots
To smooth the product flow in the cold rolling mill and to optimize production lots, including the aims of increasing coil size and improving the organization of the batch-annealing charging system. To achieve improvements in productivity and yield and decreases in costs, such as reduction in unit material consumption and energy use, thereby improving the operational soundness of the cold rolling mill.

3 Process of System Development

Figure 1 shows the process of system development. At the time of system change-over, a simultaneous change-over of all the lines and systems was undertaken, because the functions of the new system differed greatly from those of the old system, and the system design for conversion of the lower-rank O/Cs and P/Cs (Process computers) was difficult in terms of hardware.

4 Hardware Configuration and Distribution of Computer Functions

4.1 Hardware Configuration

Figure 2 and **Table 1** show the hardware configuration of the new system. The system has a 4-stage configuration of C/C (Central computer), O/Cs, P/Cs and DDCs (Direct digital controllers). It is important to note that with business computers such as the C/C and O/Cs, machines of the same series can be introduced, in consideration of future expansion possibilities and maintainability. The P/C system is divided into the tandem mill system and CAL (Continuous annealing line) system. These two system have common standby P/C's, which will facilitate system development of models for

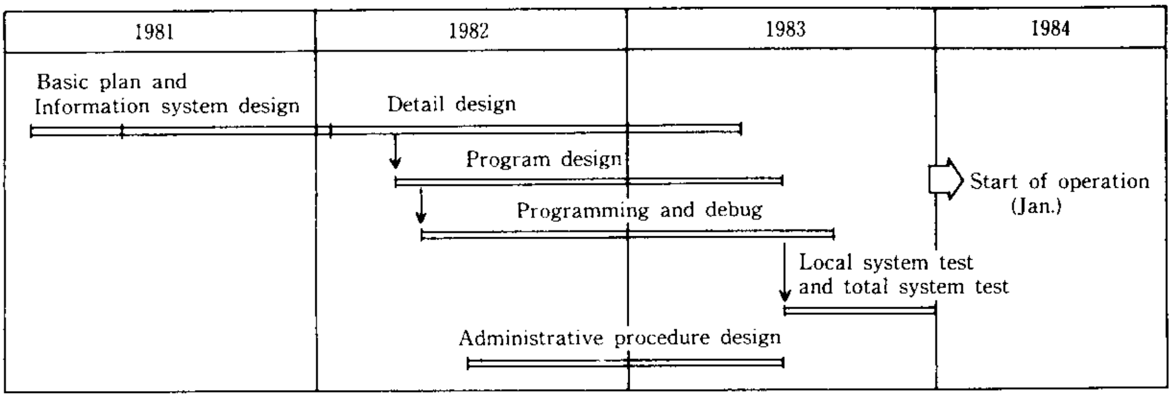


Fig. 1 Schedule of the system development

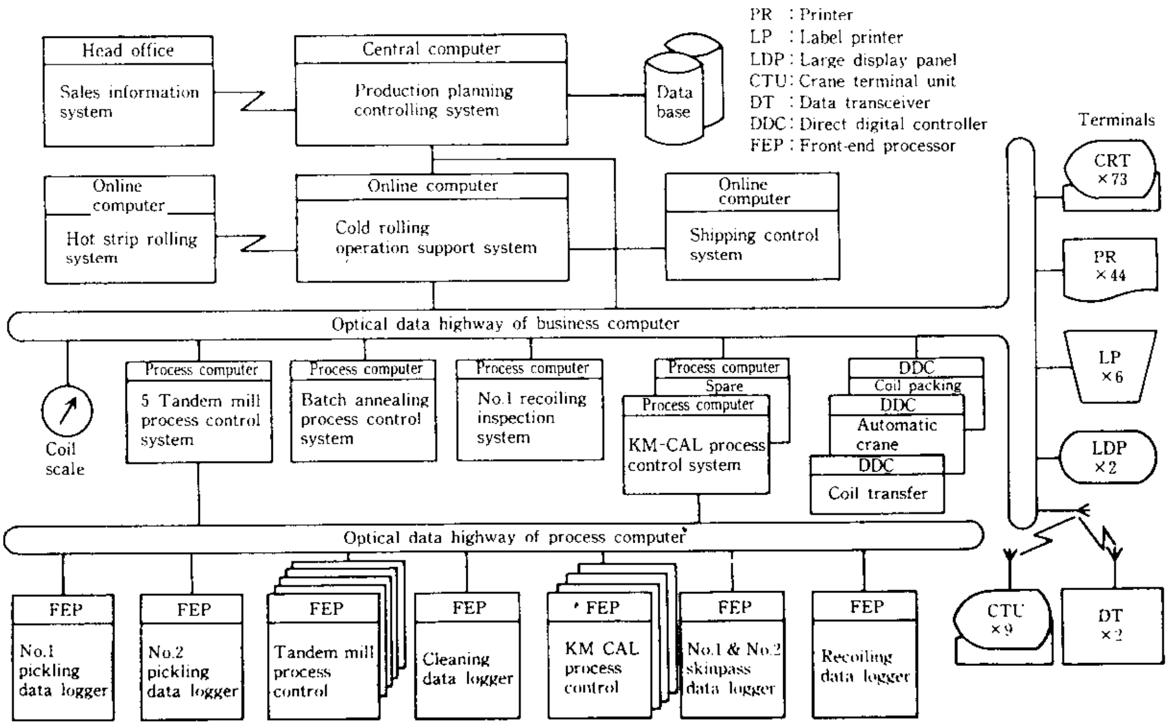


Fig. 2 Configuration and functions of the system controlling cold rolling sheet & strip production at Mizushima Works

automatic control of the respective systems and simultaneously act as a countermeasure against computer-related shutdowns of the two systems (**Table 2**).

4.2 Distribution of Computer Functions

The degree of recent improvements in P/C capabilities has been noticeable, and therefore, the new system has been so designed that the distribution of functions between the upper-rank computers and P/Cs will have the following 4-stage configuration:

(1) C/C
- (a) Quality design
- (b) Planning function including material requisition and appropriation of materials on hand to meet given orders
- (c) Preparation of manufacturing instructions for each line
- (d) Production progress control from tapping through shipping
- (e) Monthly reporting of production results
- (f) Quality and operation control in EUL (end-user language)[4]

(2) O/C
- (a) Works level material handling control and coil yard control
- (b) Collection of data on quality and operation
- (c) Man-machine interface arising from manual coil handling
- (d) Summerizing of those quality and operation data values which require rapid reporting (reports of operation by shift and daily reports of operation)

(3) P/C
- (a) Total control of automatic process control
- (b) Total information control of coil tracking
- (c) Automation presetting calculations and adaptation of on-line control models
- (d) Presetting of lower-ranking DDC
- (e) Data logging

(4) DDC
- (a) Automatic control of each process equipment
- (b) Local information control of coil in each process

5 System Outline

5.1 Development of Plan-oriented Production Control System

The conventional production control method of cold-rolled sheets and strip products employed a method of production control in which orders was grouped. It was thus comparatively easy to meet delivery dates even given the occurrence of rejects, because ① order lots were of large, lump size, ② diversified quality requirements were as yet a comparatively minor consideration, and ③ the method provided a relatively easy means of coping with the occurrence of unstable quality. In this method, the disposition of materials in process to meet

Table 1 System configuration, hardware and software

System	Item	Quantity	Note
Center computer system	Hardware		
	FACOM M-380	2	Central common machine
	CRT & Keyboard (Japanese)	8	Color CRT
	Printer (Japanese)	6	
	Business graphic display	3	
	Business graphic printer	3	
	Software	494 k steps	COBOL
On-line computer system	Hardware		
	FACOM M-170F	1	
	CRT & Keyboard	8	1920 characters, color CRT
	Printer	17	
	CRT & Keyboard (Japanese)	54	Color CRT
	Printer (Japanese)	18	
	Label printer	6	
	Large display panel	2	
	Crane terminal	9	480 characters
	Process control unit	5	
	Data transceiver	1	
	Software	529 k steps	COBOL
Optical data highway system (North trunk line)	Master station	2	
	Center station	4	
	Field station	9	
	Cable length		
	Main loop	5.1 km	Double
	Sub loop	3.1 km	Single
	(Cable total length)	8.2 km	
Other connected computer	On-line computer[2,3]	2	
	Process computer	4	
Data base	Total volume	2 500 MB	

given orders was virtually updated completely on a daily basis covering the entire range of processes from upstream to downstream. Further, in the finishing line, an optimum material for the given order was traced on-line from among all materials in process, and that material was assigned to the finishing line as best for the order.

However, such a method of production control by grouping orders has now lost its value, because of ① requirements for production of higher-grade steels in more diverse types and smaller lots, ② stabilization of quality due to progress in manufacturing techniques for cold rolled sheets and strip, and ③ enhancement of plan-oriented methods accompanying the synchronization and continuation of processes. The new system, therefore, employs a "made-to-order" method of production control in which the assigning of material to an order through the entire stage from tapping to finishing line is securely determined. As a result, on-line assignment of material to an order in the finishing line has been abolished and the assignment function has been fundamentally unified under the control of C/C. Assignment exchanges for orders made by manual intercession are now limited to the cases where it is absolutely unavoibable.

Raw material for cold rolling is ordinarily designed according to the maximum capacity specification of cold rolling facilities, and therefore, a difference tends to occur between the material quantity and total ordered weight, resulting in a surplus on the material side. If this surplus flows into the finishing process, it may cause disturbances in the plan and a lowering of yield. Thus, when the made-to-order method of production is used, reducing this type of surplus in the process stages becomes a vital problem. As measures for reducing material surpluses, the following have been adopted:
(1) A surplus appropriating function has been devel-

Table 2 Configuration of hardware and software in process computer system

System	Item	Quantity	Note
Tandem mill system	Hardware		
	HIDIC V90/50	1	5 MB
	CRT & Keyboard	5	
	Typewriter	2	
	Optical data highway system	3.0 km	
	FEP HIDIC 08L	8	5 : TA 2 : Pickling 1 : Cleaning
	Software		
	TA	50 k steps	
	Data logger	25 k steps	
Continuous annealing system	Hardware		
	HIDIC V90/50	2	5 MB SPARE 1
	CRT & Keyboard	5	
	Typewriter	2	
	Optical data highway system	2.0 km	
	FEP HIDIC 08L	6	4 : CAL 1 : Skinpass 1 : Recoiling
	Software		
	KM-CAL	70 k steps	
	Data logger	20 k steps	
Batch annealing system	Hardware		
	YODIC 100	1	16 kW DRUM 256 kW
	FACOM 270/10	2	4 kW DRUM 32 kW
	CRT & Keyboard	1	
	Typewriter	3	
No. 1 Recoiling surface defect inspection system	Hardware		
	TOSBAC 7/40	1	512 kB Floppy disk
	CRT & Keyboard	1	
	Typewriter	1	

oped in which new orders and orders using rescheduled material are first assigned so as to utilize the surplus in process; only after then are materials required for unfilled orders requested.

(2) Orders with the same manufacturing specifications are grouped into optimum lots taking into consideration the delivery date, and then raw materials for the grouped orders are requested.

(3) A manufacturing technique has been developed to cold roll steels having different rolled thickness from a single hot coil (called the "process of cold rolling a hot coil to give multi-thickness from one segment to another"). Further, this method has made it possible so that the number of the segments of different thickness can vary according to the amount of orders.

Manufacturing techniques for cold rolled sheets and strip have been greatly improved in comparison with former conditions, yet there remains the possibility of occurrence of rejects. In such cases, the new system reschedules the order as a material request, which results in the re-tapping of material. This method, however, causes delays in the forecast delivery date. To cope with this, a function has been developed for preventing delivery delays by preparing reserved, unassigned material, which is held as unpickled hot coil.

Since a 1 : 1 correspondence between the raw material and order, has been realized by use of the made-to-order production control method, accuracy in process control has been improved and sophisticated additions to manufacturing specifications, order by order, have become possible. The effect of this method on the enhancement of quality and the improvement of yield due to a reduction in surplus materials has been excellent.

5.2 Reinforcement of Quality Assurance System

An important role is played by the computer system in strengthening the quality assurance system. In this new, advanced total information system, supporting functions have been developed in the areas of quality planning, preparation of manufacturing instructions, quality control, quality improvement, and quality information management, taking the following points into consideration:

5.2.1 Automation of quality planning

The quality planning system should have a system structure which can determine correct manufacturing specifications on the basis of users' quality requirement. For this reason, quality requirement values have been categorized and standardized, and a quality assurance system has been developed on the basis of the following concepts:

(1) To permit automatic the design of manufacturing specifications on the basis of quality requirement values transmitted from the Head Office.
(2) To permit appropriate assignment of manpower to meet special quality requirements.
(3) To allow elastic measures to cope with the addition or revision of standards due to installation of new facilities and modification of existing facilities, as well as those due to changes in users' needs.

To make the system elastic, the standards stored in the computer were tabulated as a table of standards (computerized standards) which can be revised by respective operationing divisions.

Through the development of this function, complete automation of quality planning has been accomplished. As an exception, however, certain trial-manufacture orders are processed in the course of development.

5.2.2 Unification of manufacturing instructions

There are various kinds of manufacturing instructions such as those for (1) additions to manufacturing specifications of the order, (2) forward feeding of data from the prior processes, (3) reject processing and (4) experimental specifications for quality operation and cost-saving improvement purposes. With the trends toward higher grade products and product quality diversification, any temporary delay in standardization will cause a delay in system maintenance. Thus there is a possibility of increasing the number of standards and special operational instruction in writing. Operational instructions to operators have become so multidimensional, however, as to hinder operation in some cases.

As a result, standards have been thoroughly systematized, and functions for rejects control and experimental material management have been developed, thus achieving the unification of operational instructions to operators and the abolition of operational instructions in writing. The rejects control function supports the registration and processing of rejects, transmission of information about rejects to the succeeding process, and analysis of this information. The experimental material management function has an experimental material management data base which controls in bulk all the experimental material instruction information shown in **Table 3**. At the time of preparing manufacturing instructions, the experimental material instruction is given by referring to this data base. In particular, the development of this function and introduction of terminals using the Japanese language have allowed the display of written information a maximum 300 characters in length on CRTs to improve operating efficiency.

Table 3 Contents of data base for experimental activities

Item	Contents
Fixed instruction for operation	(1) Preset data by P/C (2) Display data on CRT (3) Presence & sampling
Floating instruction for operation	(1) Difficult elements to instruct by numeric (2) Difficult elements to predict beforehand (3) Manual operations to change (Instruct by Japanese with 10 characters inputted by code (total 300 characters))

5.2.3 Development of sensor base system

Automation of the manufacturing process is indispensable in maintaining high quality in products. In the manufacture of cold-rolled steels, gage control, flatness control, and furnace temperature control are automated. Automatic control of the surface properties of cold rolled steels, however, has not yet been realized. With the trends toward multi-kind and highquality operation, the following problems have appeared:

(1) Some of the causes of rejects which occur during the manufacturing process cannot be found quantitatively.
(2) Since direct causes of rejects are beyond reach, control is limited to indirect manufacturing causes on an experimented manner.
(3) As product grades be come more diversified, manufacturing conditions have also become so widely diversified as to exceed the limitations of human control.

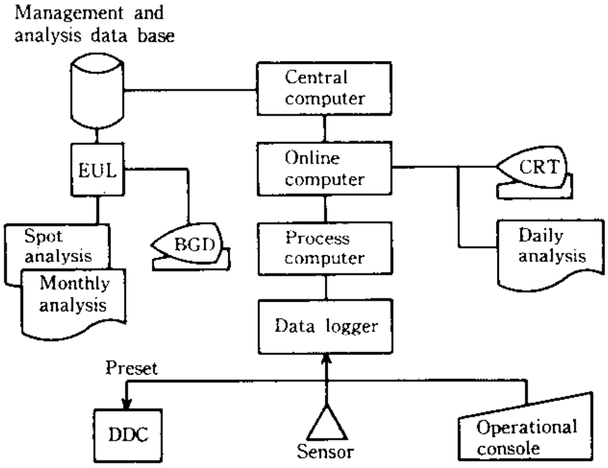


Fig. 3 Schematic flow of sensor base system

To solve these problems and allow further progress, it was necessary to find a method of collecting and analysing bulk data more quickly and accurately and of having the analysis results efficiently reflected in the production of high-quality products. It was also necessary to promote automation. As a result, a sensor base system was developed through the introduction of P/Cs and sensors (109 units). **Figure 3** shows the outline of the system.

This system has the following features:

(1) Maintenance of high quality by automatic setting of important quality items
(2) Prevention of mass occurrences of rejects by constant monitoring of manufacturing conditions
(3) Rapid analysis and efficient quality maintenance operation realized on the basis of the quality and operation control data base
(4) Enhancement of analysis accuracy through the collection of quantified quality and operation data and, further, transmission of information to succeeding processes

Table 4 Quantity of information by sensor base system

Process	Quantity of information (byte/coil)
Pickling	768
Tandem mill	9 728
Cleaning	768
Batch annealing	680
Skinpass mill	768
Recoiling	768 (1 536)*
Continuous annealing	24 704

* Only No. 1 Recoiling line

(5) Relief of operator workload through the automatic collection of quality and operation information. **Table 4** shows the quantity of data which has been automatically collected by the sensor base system.

5.2.4 Construction of quality and operation control data base

In the past, quality information was stored for future use on paper as written instructions, daily operation reports, chart information from measuring instruments, and so on. In the new system, such quality operation information is all field in the C/C to construct a control analysis data base.

The data base consists of quality and operation data, instruction information, material data, facility control data, and information for adaptation of P/Cs to the online model. It is stored in an efficient, easily searched and analysed file form.

The open use of the data base is promoted, and TSS (Time-sharing system) terminal and EUL are used. The data base also permits on-line information search and integrated quality analysis among steelmaking and hot and cold rolling, thereby exercising noticeable effects not only on quality improvement but also on operation-improvement and cost-reduction activities.

5.2.5 Improvement in standards-controlling function

Standardization of quality control activities will be increasingly required in the future. As various standards are made into computerized standards, standards control has increased in importance and, accordingly, it has become necessary for users to understand and use the computerized standards.

To improve the understanding of computerized standards, prevent of errors in revision, and maintain security, a computerized-standards control function with the following functions has been developed:

(1) Automatic search and outputting of the program index that uses the standard concerned.
(2) Registration and outputting of the names of standards corresponding to the standard concerned and the intervals of periodical reviewing.
(3) Prevention of revision by persons other than the standards controller by use of individual input codes.
(4) A two-step standard revision system consisting of ① a check of the contents of the standards correction and ② validation of the standards correction after its approval and inputting.
(5) Outputting of the standards control ledger and standards table summary chart, as well as revision of a computerized, conversational-type standards table on the computer screen, all in Japanese.

5.3 Facilitation of Material Handling

Smooth material handling is important in the case of cold rolled steels, not only for improving productivity and shortening lead times, but also for quality control. In the following, the function of the new system in supporting smooth material handling is explained by reference to a typical example.

5.3.1 Pickling command

Material handling control in weekly units at the cold rolling mill is effected by the pickling command.

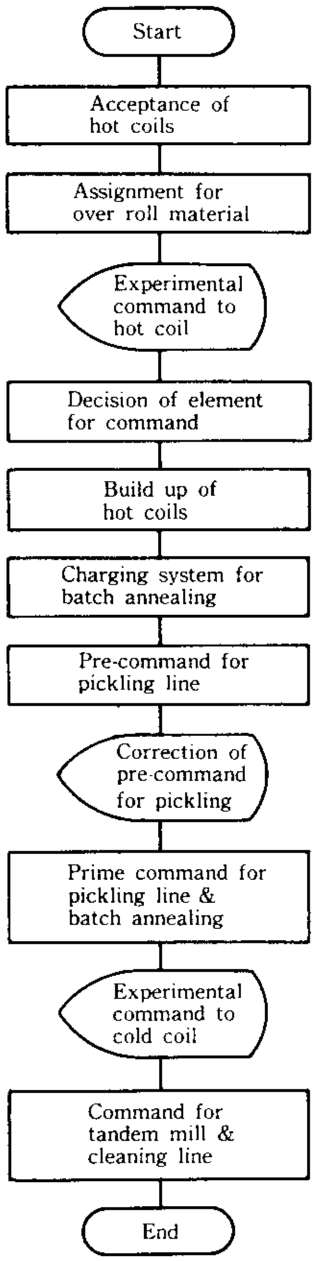


Fig. 4 Flow chart of pickling and tandem mill command

Figure 4 shows the flow chart of the pickling command.

First a pickling pre-command is issued to select from the hot coil stock necessary materials in planned amounts corresponding to the capacities of the respective processes at the cold rolling mill. The main factors in this selection are the cycle of cold rolling, batch annealing charge organization, and delivery date. The pickling prime command is outputted after the pickling pre-command is corrected, as and when necessary, by human judgement.

Furthermore, automatic outputting of prime commands for the tandem mill, cleaning process, and batch annealing has ensured smooth material handling in the upstream operations in the cold rolling mill.

5.3.2 Command concerning skinpass and conditioning processes

In the conventional skinpass command, all the coils cooled in the cooling yard were taken in the scope of the command. As a result, it sometimes occurred that at the conditioning process which followed, the flow of coils became congested, causing stagnant coil processing and posing problems in process control as well as quality control.

In the new system, only the necessary amounts of materials for the respective skinpass and conditioning processes are included in commands. In this way, systematic material handling is achieved. Features of this skinpass and conditioning command formation are:

(1) Commands can be formulated as and when necessary by use of the on-line conversational model at the field process control room.
(2) Through inputting the processing time of the respective skinpass and conditioning processes, the commands can be formed for amounts which match the capacities of the respective processes.
(3) Commands can be formed specifying numbers of coils of special materials which require special rolls at the skinpass mill, center-slitting, special oiling, and so on.

5.3.3 Improvement in accuracy of material handling control

(1) Stock Control and Process Prediction Control
Renewal of the online data base stored in the C/C permits easy, accurate, and rapid determination of the status of stock, covering a wide range of materials as well as order status.
For formulating production plans and mill operation plans, a production plan achievement prediction function and a line load prediction function have also been developed on the basis of the estimated date on which material will pass the respective processes. These dates are set at the time of tapping, and estimated dates are revised and updated

as the coil passes each respective process.

(2) Coil Yard Control
To improve the accuracy of coil stock control, a coil yard management function has been developed, covering the entire cold rolling mill area. To give a operation command to the crane operator, a crane terminal unit mounted in the operator's cabin has been introduced. This unit gives a greater amount of information than the conventional large display panel, and demonstrates effectiveness in preventing errors in material selection and in improving operational efficiency.

5.4 Optimization of Manufacturing Lots

5.4.1 Increase of coil size

Increase in the unit size of cold rolled coil is important in improving yield and productivity and in facilitating material handling. There are limitations, however, on maximum hot coil size imposed by slab size and the capacity of the hot rolling facility. This makes it impossible to request hot coils for cold rolling in maximum size processible on the existing cold rolling facility. As a result, a number of hot coils are built up at the pickling process so as to turn into a larger cold coil.

This build-up procedure is divided into two groups: One group being coils with similar manufacturing specifications; the other, a non-uniform build-up group of different specification. In the new system, optimum combinations are used, taking into consideration the factors shown in **Table 5**, and the non-uniform build-up group has been promoted. It has become possible to build up as many as four hot coils.

Table 5 Relation between uniform build-up and non-uniform build-up

	Regular build up	Irregular build up
Hot rolled strip thickness	=	*
Cold rolled strip thickness	=	*
Grade	=	=
Strip width	=	*
Tandem operations	*	*
Skinpass operations	*	*
Annealing operations	*	*
Recoiling operations	*	*

= : Building up coils of almost the same specification
* : Building up coils of different specification

Through this non-uniform build-up process, together with the multithickness cold rolling of a hot coil described earlier, it has become possible to manufacture cold rolled coils having a maximum of four different finishing thicknesses.

5.4.2 Development of batch annealing charge grouping function

The batch annealing charge grouping is based on CAPS[5] (Coil annealing prediction system) and aims at optimizing the stacking order (**Fig. 5**) to minimize the heating time difference between the respective coils stacked, while maximizing the charge weight. For instance, case 3 in Fig. 5 is the charge grouping with the best stacking order.

Case	1	2	3
Stacking order & the required heating time for each coil	Coil width (mm) / Required heating time (h) 800 / 33.0 900 / 37.6 1 200 / [38.8] 1 000 / 31.3	1 000 / 41.0 1 200 / [46.5] 900 / 32.9 800 / 27.3	900 / 35.4 800 / [35.5] 1 000 / 34.2 1 200 / 34.7
Difference of the required heating time for each coil (h)	7.5	19.2	1.3
Required heating time for charge (h)	38.8	46.5	35.5
Energy consumption ($\times 10^3$kcal/t)	182	192	176

Fig. 5 Relation between stacking order and calculated energy consumption per charge

When performed before the pickling command, this charge grouping permitted increased size of coils, leading to optimum charge grouping and coil loading to the base according to given commands. The development of this function has contributed to uniform quality of products, improvement in operational efficiency, and cost saving.

6 Features of System Techniques

6.1 Introduction of New Hardware and Development of Utilization Techniques

(1) Realization of Large-scale Computer Network by Optical Data Highway
Mizushima Works is now in the process of laying an optical data highway which is to be a communication means effectively connecting computers and terminal groups now widely separated in the various plants. It will be a main link in the Works level total information system structure. The optical data highway adopted here consists of two trunk lines that divide the entire Works compound into the north and the south zones, with each trunk line subordinating sub-loops for various operating units, so as to minimize the impact of operation problems in their locality and to ease future system expansions for new facilities added.

(2) Introduction of Terminals Using Japanese Language
The tricolored Japanese-language display unit and printer have been modified to be dust-proof and are used as operation terminals at the cold rolling mill (**Photo 1**).

(3) Active Use of Business Graphic Display (BGD)
BGD was introduced as a means of improving various control tasks, so that any desired control information can be easily obtained on-line. They are now actively used in the respective areas as tools of various control activities.

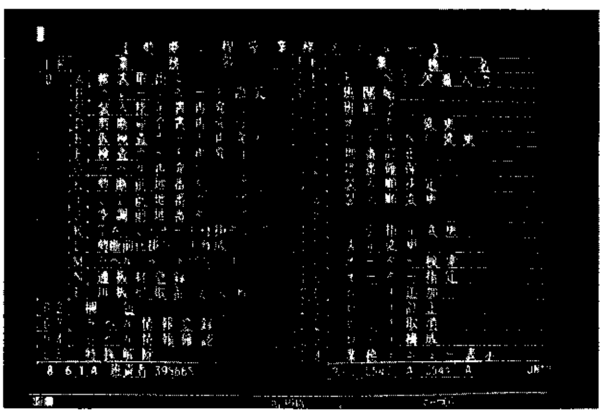
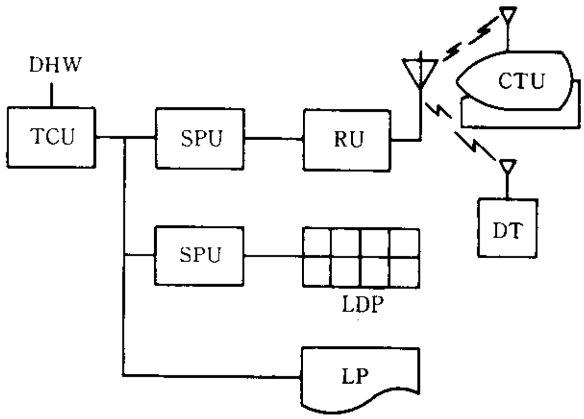


Photo 1 Example of display on CRT



TCU : Terminal control unit
SPU : Station processor unit
RU : Radio unit
CTU : Crane terminal unit
DT : Data transceiver
LDP : Large display panel
LP : Label printer
DHW: Optical data highway

Fig. 6 Configuration of special terminal units

(4) Active Use of Special Terminals
In addition to the normal standard terminals, special terminals such as crane terminals, data transceivers, large-sized display panels, and label printers are actively used to give timely operational instructions and to collect online data at each unit of operation. **Figure 6** shows the configuration of a typical special terminal unit.

6.2 Application of Support Software for Development Activities

At the time of development of the total information system, the development of a production control system for billets, blooms, and beams, in a scale 1.5 times as large as the total information system, was simultaneously underway. Thus the availability of computer resources and development personnel were in short supply. To promote the development of a major project against this background, various measures for productivity improvement and development of support tools have been taken centering on Systems department.

(1) Application of System Development Technique, PRIDE[6]
PRIDE (Profitable information by design, registered trade marks of M. Bryce & Associates Inc.) is a method which stipulates the operation procedure for system design and emphasizes the importance of information resource management. The new total information system was developed from the start along the same lines as PRIDE, and has achieved

high efficiency and productivity throughout the entire system development, assisted by the application of support tools as mentioned below.

(2) Application of Data Controlling Tool
As a computer support tool for the information resource management of PRIDE, the data dictionary, SORID (System organization and resource information dictionary),[7] which was independently developed by Kawasaki Steel, has been fully used in data control. SORID also has functions of automatic preparation of recording formats of computer files and of outputting the program list with titles in Japanese, in addition to its use as a data controlling tool, thereby efficiently supporting development and maintenance operation. The new total information system registers 6 000 items related to cold rolling and effectively contributes to increased efficiency in system maintenance and to data utilization by operational divisions and open users.

(3) Application of Program Automatic Generation Tool
As an automatic generation tool of the COBOL (Common business oriented language) program, PARTS (Pattern and parts oriented requirement translations system), which was independently developed by Kawasaki Steel, has been used to improve productivity in areas ranging from program design to programming.

7 Concluding Remarks

The new cold rolling total information control system, which was constructed as part of the Mizushima Works total production control system, has been outlined. In developing the new information system, all the related deivisions in Mizushima Works cooperated in development through all stages from the initial period of development. New techniques, such as computer utilization techniques and system development techniques, have been introduced. Consequently, the system has been functioning smoothly since start-up, and has demonstrated remarkable effectiveness, although still only recently inaugurated. New techniques developed and introduced into the total information system are being effectively used in subsequent system development.

At present, the development of a total process planning system centering around sheet production lines is underway at Mizushima Works. This system is expected to go into operation in 1968. Through the commissioning of this total process planning system, it is expected that the new cold rolling total information control system will also demonstrate its effectiveness.

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