UDC 669.1.012-52

PROCESS CONTROL SYSTEM IN ENERGY CENTER OF STEEL MAKING PLANT

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I. INTRODUCTION

Steel making plants employ various kinds of energies such as electric power, heavy oil, tar, coal, blast furnace gas, coke furnace gas, converter gas, steam, water, oxygen, and compressed air, for example, and these energies are closely related to each other. In order to control these energies systematically to improve the plant operation efficiency and reduce energy costs, an energy center is installed in these plants.

This paper will introduce an outline and recent tendencies of the energy center equipment plus detailed examples.

II. BASIC FUNCTIONS OF ENERGY CENTER

The energy center generally provides the following functions.

(1) Monitoring of energy flow
(2) Economical distribution of energies
(3) Rationalization of operation
(4) Emergency treatment of accidents

In recent years,

(5) Environmental and disaster-preventive center function is sometimes included in the energy center. *Fig. 1* indicates an example of the basic system of this energy center.

(1) Regarding the drive power (fuel, oxygen, nitrogen, steam, etc.), electric power, and industrial water energies to be controlled by the energy center as controlled objects, the information is sent to the energy center from energy generating shop, energy equipment, and major energy-consuming shops being controlled by the energy center.
(2) The energy center indicates these pieces of information on the centralized supervisory panel (or, instrument panel) and operation desk, and also inputs these data to the energy center computer.
(3) The operator adjusts the demand and supply of ener-

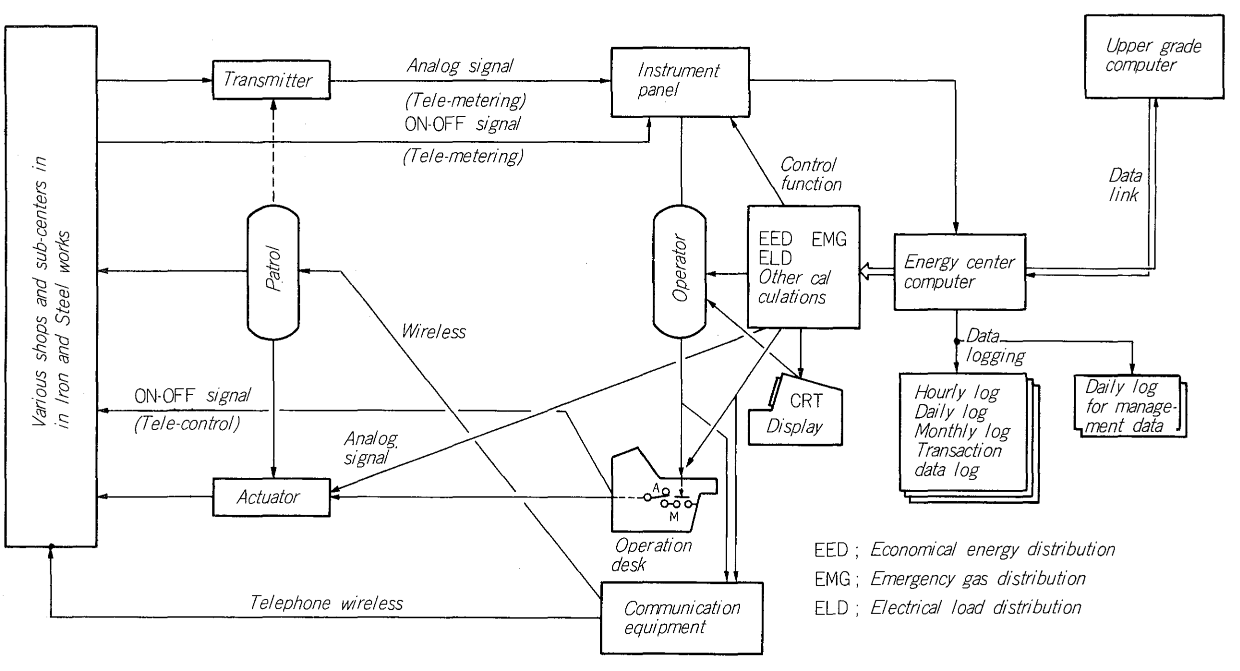

Fig. 1 Communication flow diagram in energy center.

gies of the entire plant according to the displayed data on the instrument panel and operation desk, indications on CRT display, and data logging sheets.

(4) The energy center directly sends operation and control commands to the energy equipment. Also, the communication equipment sends the demand and supply commands to operators of other shops.

III. OUTLINE OF THE COMPONENT UNITS IN ENERGY CENTER

The energy center equipment is generally composed of the following units or systems.

(1) Remote measuring control system
(2) Remote supervisory control system (Telemeter telecontrol unit)
(3) Energy center computer
(4) Uninterruptible power supply
(5) Communication equipment
(6) Trunk cables

1. Remote measuring control system

This system consists of the unit for measuring variables, such as flow, pressure, temperature, level, opening, voltage, current, electric energy, etc., and transmitting these data to the energy center, plus the recorder, controller, instrument panel, and operation desk for monitoring and controlling functions in the energy center.

The instrument panel is designed for easy monitoring by operator. Its panel dimensions and mounting layout of devices are determined by fully examining the man-machine interface. Regarding the panel system, a semi-graphic system or a non-graphic system is recently popularized as the CRT display spreads, without executing the total graphic system. In order to realize energy-saving, the energy center positively introduces an effective utilization system of by-product gases for various measuring control systems as well as gas mixing system.

For the purpose of qualitatively improving complicated control functions in these systems, a micro-computer-applied digital instrumentation system is widely utilized in recent years.

2. Remote supervisory control system (Telemeter telecontrol unit)

This unit is installed to execute centralized supervisory control in the energy center for the purpose of realizing the unmanned operation in local equipment. The transmission between the energy center and the local equipment is made by a direct-feed system or telemeter telecontrol system.

Unlike the direct-feed system which installs a pair of cables every monitoring and control item, the telemeter telecontrol system sends several hundreds of signals through two pairs of cables.

(1) Gas station (gas booster, gas holder, combustion tower, etc.)
(2) Heavy oil and industrial water pump station
(3) Substation power plant, electrical room, and other substations

The telemeter telecontrol system is provided with its master station in the energy center and slave stations in local stations. It ususally adopts the 1 (master station) : 1 (slave station) system. However, it may sometimes adopt the 1 (master station) : N (multiple slave stations) system.

3. Control center computer

The control center computer is indispensable for utilizing a huge number of information being concentrated into the energy center for operator's operation and energy-saving, manpower-saving, and others in steel making plant.

The control center computer was first started with a simple logger and a monitoring of energy flow. Then, it executed the demand/supply balance adjustment of energies, economical distribution of energies, various predictive control, and high-grade data processing to obtain definite results in effective utilization of by-product gases, stable operation of equipment, and reduction of primary unit.

Also, various noticeable development and modifications were made, such as completeness of display function using CRT display, operation ease, etc.

Data ways were positively introduced for the extension of the service range of computer, improvement of control accuracy, necessity of high-speed wide-range data transmission by means of the linkage with other process computers, and an increase of monitoring and control points, while taking future cable work costs and maintenance of multi-core cables into consideration. *Fig. 2* indicates an example of system configuration.

4. Uninterruptible power supply

It is necessary for the energy center to display its functions sufficiently when a power failure or other sudden accident occurred in the center as well as during the steady-state energy operation. For this purpose, the power interruption is not permissible in the energy cente. As a countermeasure, the energy center receives its power supply from two systems at least. If power was interrupted in these two systems simultaneously, the energy center receives power from batteries, and converts it into AC to feed power to each unit in the energy center. In addition, a static CVCF system is often employed as an uninterruptible power supply.

5. Communication equipment

The energy cente comprises periodical patrol maintenance service of the energy equipment, service of communicating daily demand and supply adjusting results to shops, and service to send an emergency command to these shops or the entire plant in case of the occurrence of a trouble, as well as operation service of the drive power equipment, receiving power and substation equipment, etc.

Accordingly, the communication equipment is generally installed. As this communication equipment, the paging equipment is available to send communication commands between the energy center and shops or the "radiotele-

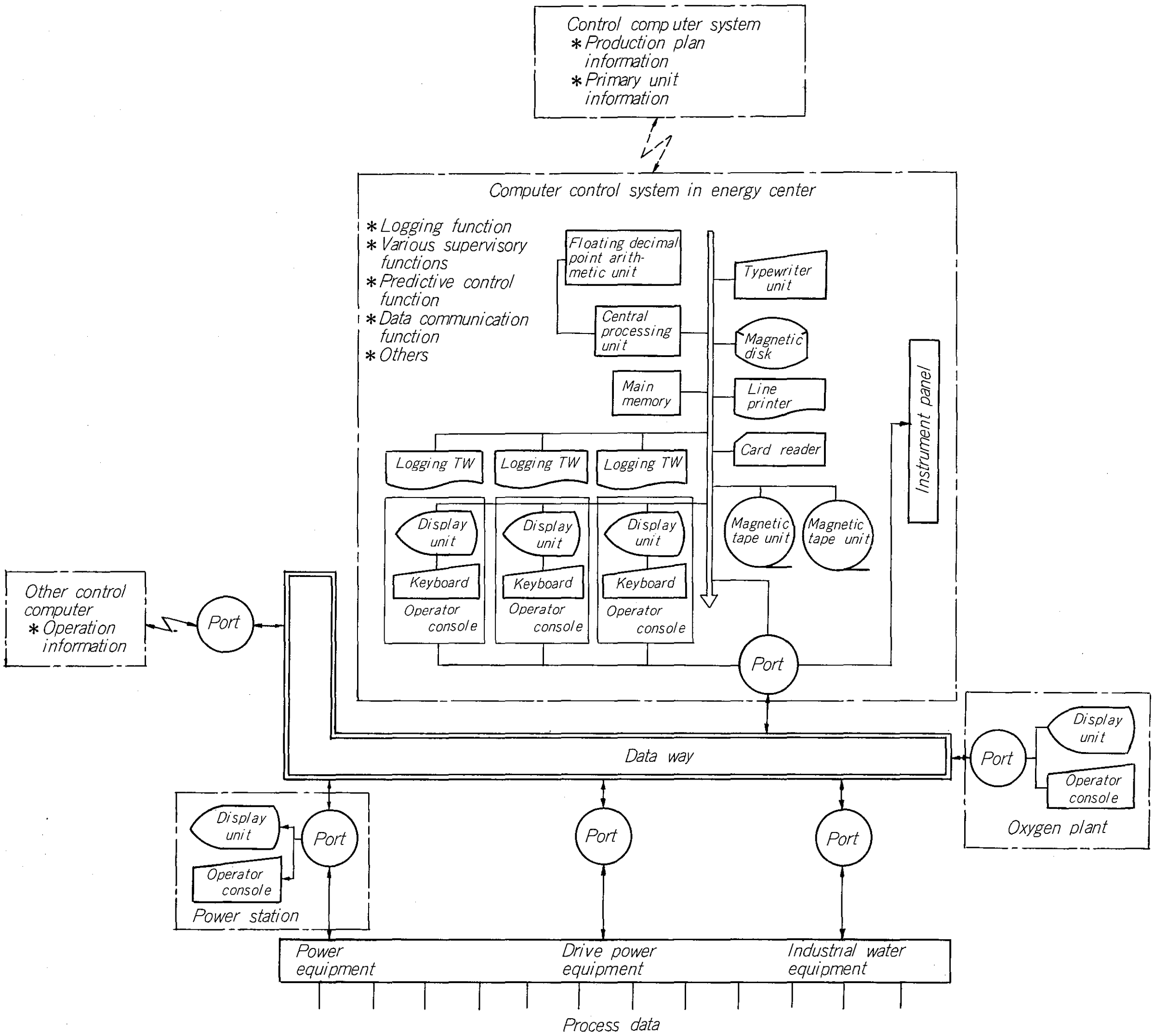

Fig. 2 Example of computer control system in energy center

phone equipment" to execute communications and commands between the energy center and patrol cars and also between respective patrol cars. In accition, the "automatic voice information unit" is installed recently for communicating trouble contents with the operator as well as lamp dispaly on the instrument panel and operation desk when the equipment or energy flow is in trouble.

6. Trunk cables

The energy center trank cables feature the following items, unlike general instrumentation cables.

(1) Long signal transmission distance
(2) Versatile cabling routes
(3) Many input/output points
(4) Many signal terminations with other equipment
(5) A trouble, if happened, largely affects other equipment.
(6) Long work period (this depends largely upon other equipment)

In the energy center instrumentation works, the selection of transmission cables or trunk cables is an important problem, as compared with working cable selection.

In order to send a huge number of versatile signals over a long distance, cables must be selected to meet the following conditions.

(Selective conditions)

(1) Economical
(2) Electrical characteristics and mechanical characteristics are provided.
(3) Resistible against external noises (inductive interferences)
(4) Convenient for maintenance and use
(5) Resistible in special environment

IV. OUTLINE OF OHGISHIMA ENERGY CENTER EQUIPMENT

The Nippon Kokan K.K. Keihin Iron and Steel Works, Ohgishima energy center is the greatest system in Japan. This energy center contains wide controlled equipment, such as drive power, industrial water, electric, and environmental equipment, and it was built by concentrating the latest techniques as well as conventional techniques. Now, an outline of this Ohgishima energy center will be introduced.

1. Outline

The Ohgishima energy center executes integrated control of various energies employed in the Ohgishima district to allow the telemetering telecontrol operation of the drive power equipment for efficient operation of various energies, reasonable equipment operation, and manpower-saving to meet the demands of energy-saving, resource-saving, manpower-saving, and environmental measures. It also collects data of fuels and other variables from the premises of the center and other adjacent districts so as to keep track of environmental conditions of the entire plant, and control these conditions to take a necessary measure. (See *Fig. 3*.)

2. Functions of Ohgishima energy center

1) Systematic demand and supply control of various energies
- Generates, receives, and consumes various energies such as gas, compressed air, oxygen, nitrogen, industrial water, etc. while balancing the generation, receive, and consumption, and it maintains the plant operation stably.
- Executes appropriate demand and supply of energies according to production plan.
- Promotes energy-saving to reduce the primary unit, while keeping track of the drive power costs.

2) Effective operation by telemetering
- Supplies energies stably by means of gas mixing control and heavy oil mixing control.
- Concentratedly keeps track of the demand and supply conditions of energies, tidal current, and drive power equipment operation by means of telemetering for the purpose of effective operation of energies.

3) Rationalized operation and manpower-saving by telemeter telecontrol operation
- Concentralizes the operation of the drive power equipment being individually installed for the purpose of manpower-saving.
- Attempts reasonable plant operation according to the demand and supply conditions.

4) Appropriate environment monitoring and control processing
- Collects various data of the entire plant such as fuels, exhaust gases, drainage, etc. so as to keep track of environmental conditions.
- Executes appropriate treatment to keep the regulative values and other standard values for the purpose of establishing appropriate environment monitoring.
- Takes countermeasures quickly according to commands from the prefectural of municipal office in case of an emergency.

5) Stabilization of drive power equipment
- Quickly catches an abnormal condition of the equipment and takes a measure to stabilize the equipment.

3. System configuration and layout

1) System configuration

The Ohgishima energy center consists of the following system.

(1) Remote measuring control system
(2) Remote supervisory control system
(Telemeter and Telecontrol)

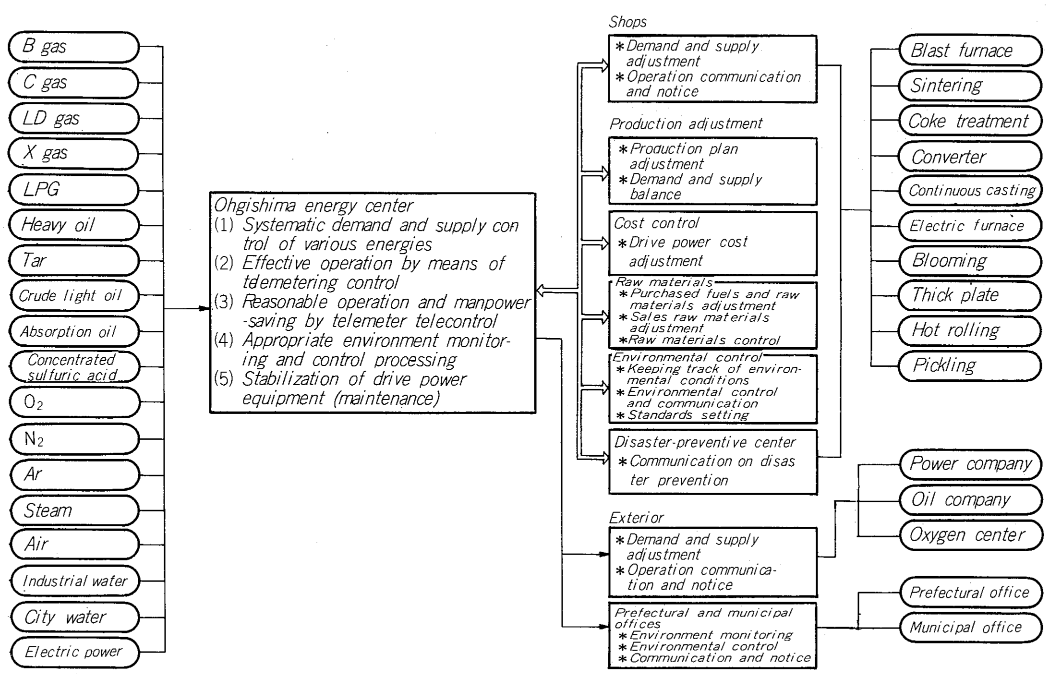

Fig. 3 Total management system in Ohgishima energy center

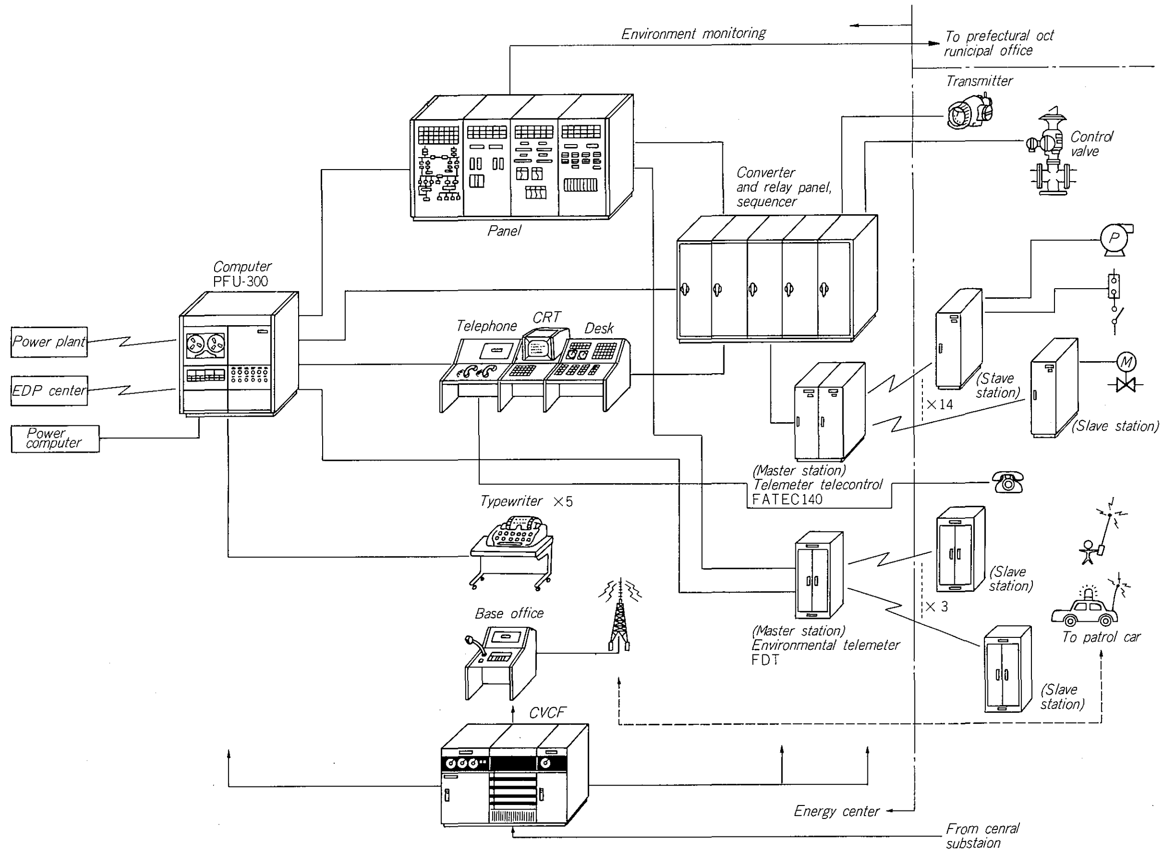

Fig. 4 Total configuration of Ohgishima energy center

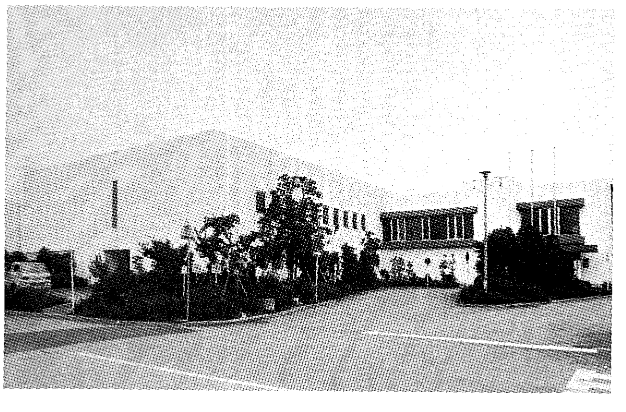

Fig. 5 Outside view of Ohgishima energy center

(3) Computer control system
(4) Environmental control system
(5) Power supply system
(6) Communication system
(7) Trunk cables
(8) Disaster-preventive control system

Fig. 4 indicates the total configuration of Ohgishima energy center.

2) Building layout in energy center

The two-storied buildings of the energy center are located at about the center of Ohgishima. (See *Fig. 5*.)

The first story comprises the maintenance office, environment analytical room, water quality analytical room, electrical room, and meeting room, while the second

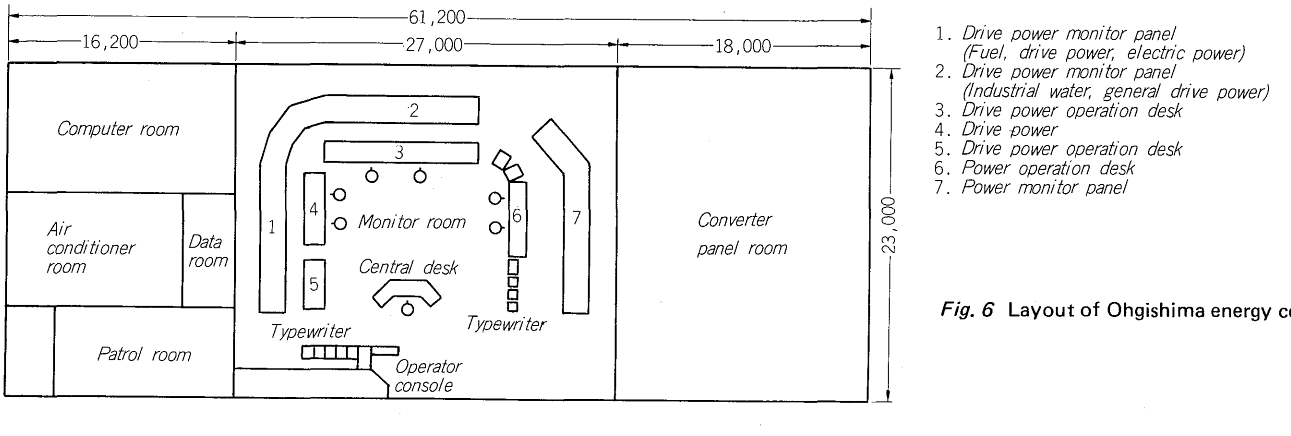

Fig. 6 Layout of Ohgishima energy center

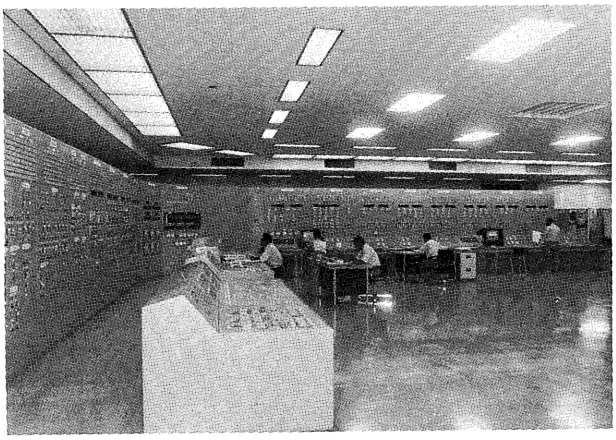

Fig. 7 Control room of Ohgishima energy center

story comprises the operation and monitor room, computer room, patrol room, and business office. *Fig. 6* indicates a part of the layout on the second story.

The following points were taken into consideration when designing the control room.

(1) In order to reduce an oppressive sensation to the operator due to large-scale panels, a capacitive space, sufficient ceiling height, and floor without columns were adopted.
This kind of control room has not been provided with any window conventionally. However, windows were provided partially to release the oppressive sensation and observe weather conditions. (See *Fig. 7*.)

(2) Indirect illumination with a dimmer was adopted by taking the total color balance including panels and desks into consideration.

4. Outline of various component systems

1) Remote measuring control system

(1) No. of measurement items

Table 1 indicates the number of measurement items.

Table 1 List of measurement items

	Flow	Pressure	Temperature	Level	Others	Total
Gas	111	23	7	10	53	214
Liquid fuel	16	3	6	29	2	56
General drive power	91	32	3	2	15	143
Industrial water	110	56	73	57	6	302
Environ-ment	16		4		56	76
Total	344	144	93	98	132	781

(2) Basic principle of measurement

1 Transmission signal

The transmission signal adopts DC 4 ~ 20 mA signal system not being affected by line resistance and noises. This system is the best suited for long-distance transmission, and it covers the total area of Ohgishima (about 2 km x 3 km) without no repeater station. The receiving instruments on the instrument panel employ a DC 1 ~ 5 V voltage receiving system convenient for instrumentation.

2 Explosion-proof (Applicable standards)

The transmitters and electrical units directly mounted to the combustible gas pipes, etc. are designated as category 1 hazard zone, while the electrical units within 5 m in radius from combustible gas pipes are designated as category 2 hazard zone. The units in these hazard zones adopt an explosion-proof structure. Also, explosion-proof works are executed in these zones.

3 Instrument power supply

The instrument power supply is AC 24 V which is safe on maintenance and check, in principle.

(3) Major measurement control systems

1 Gas mixing control system

A multiple gases and fuels mixing integrated supply system was developed as a supply method of gas fuel. This system is a method of mixing multiple kinds of gas fuels in such a ratio as to keep the Wobbe index constant, and it offers the following merits.

- If generation of by-product gases fluctuates in the plant, it can be backed up by other gas fuels (CK gas, LPG) to feed mixed gas stably.

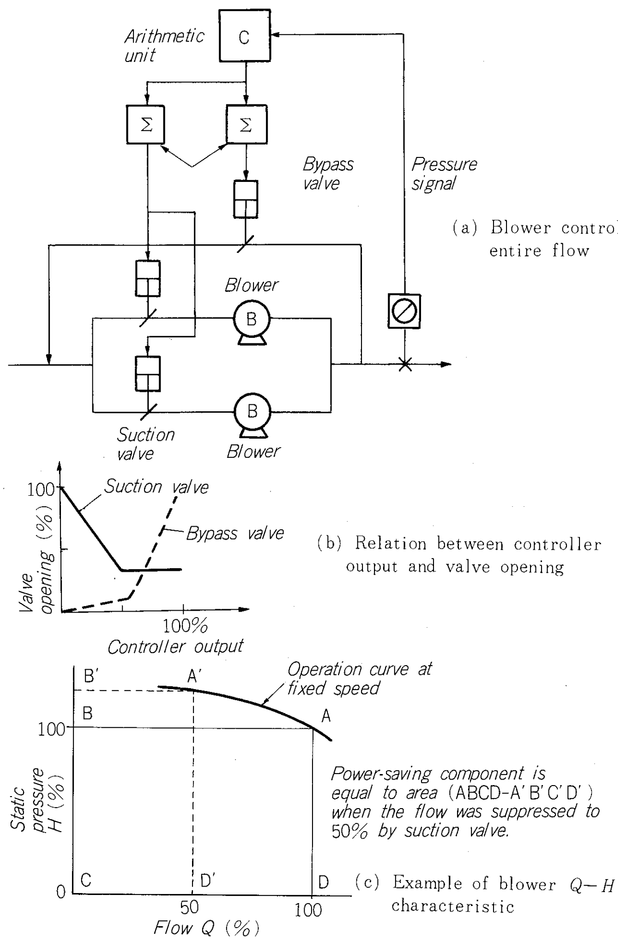

Fig. 8 Blower control

- This system eliminates production adjustment due to the shortage of gases and energy loss due to the dissipation of surplus gases.
- The standardization of fuel equipment, and simplified design of gas transport pipes can be made and the equipment inventory expenses are reduced.
- Both constant Wobbe index and constant calorific power control can be done easily in the energy center.

Details of this system were already reported in FUJI REVIEW Vol. 53, No. 7.

2 Gas blower control system

The surging prevention of the gas blower is not individually controlled, but bypass-controlled with discharge pressure so as to facilitate starting and operation.

This system features easy follow-up to an abrupt load fluctuation and high safety. In order to reduce the running cost in power expanses, the opening control of suction valve is made in addition to the above bypass valve. *Fig. 8* indicates an outline of the blower.

2) Remote supervisory control system (Telemeter and Telecontrol)

The energy equipments are decentralized at about 30 places in the plant premises. They are all unattended, and telecontrolled in the energy center concentratedly, except for a part of attended equipments such as non-utility power plant, blast furnace blower, and CDQ boiler.

This system is composed of the following four units.

1 Telemeter control unit (FATEC 140)
2 Direct transmission unit
3 Monitor panel and operation desk
4 Interface unit

(1) No. of control, display, and telemeter items See *Table 2*.

Table 2 List of control, display and telemeter item

	Drive power			Industrial water			Electricity		
	Operation	Display	Measurement	Operation	Display	Measurement	Operation	Display	Measurement
Telecontrol	127	527	2	471	2,155	255	170	1,106	121
Direct feed system	47	338	18	78	291	25	42	253	12
Total number of points	174	865	20	549	2,446	277	212	1,449	133

(2) Telemeter operation system

Supervisory system: Important equipments are monitored at all times, while general and auxiliary equipments are selectively monitored as required. If a trouble occurred in these equipments, its information is displayed at once.

Operation system: 3 operations (station selection, item selection, control) per position, in principle. Regarding emergency operation, these 3 operations can be done by 1 or 2 operations. In case of direct operation (direct transmission system), one operation is made at one position by 1 : 1 correspondence.

(3) Specifications of respective units

1 Telemeter control unit (FATEC 140)

The latest system (FATEC 140) featuring improved reliability due to the duplicated hardware design in master station and data-way function was adopted as telemeter control unit which requires large capacity and high-speed processing. FATEC 140 is a large-capacity telemeter control unit which allows the control of max. 62 controlled stations and max. 200 items, monitoring of 620 items, and measurement of 62 items controlled station. Now, it features will be described.

- The control system adopts the (1:1) x N system by time-division transmission, and all 14 stations can be controlled simultaneously. The transmission unit and control unit are duplicated to enhance reliability of the system together with a duplicated transmission circuit.
- The monitor system adopts the (1:1) x N system by independent circuits. The modem and transmission circuits are duplicated to enhance reliability.
- The master station of the monitor system comprises one auxiliary station which allows back-up operation in case of a trouble.
- For contact transfer to and from the exterior, the operation indicator lamps are attached to the contact output relays.
- The data collection time is within 3 seconds max. (62 quantity).

Table 3 indicates major specifications of the unit, and *Fig. 9* indicates the block diagram.

Table 3 Specifications of FATEC 140

Equipment capacity (per station)	Monitor; 620 items Measurement; 62 quantities (including monitoring) Control; 200 items
Transmission system	Cyclic time-division transmission
Modulation system	Frequency shift (FS) system
Synchronizing system	Frame sync.
Code system	NRZ equal-length code
Error detection	Parity, inverted double-scanning, fixed mark
Transmission speed	1,200 bits/sec
I/O conditions	Analog input : DC 1 ~ 5 V Digital input : Relay contact Control input : Relay contact Control output : Relay contact
Others	Interrupt preferential transmission is possible. Supercommutation is possible. Subcommutation is possible.

2 Direct transmission unit

This unit directly controls various units mounted along the piping of the drive power equipment and water filteration plant. The controlled objects are electric valve motor and diesel pump of the industrial water equipment and

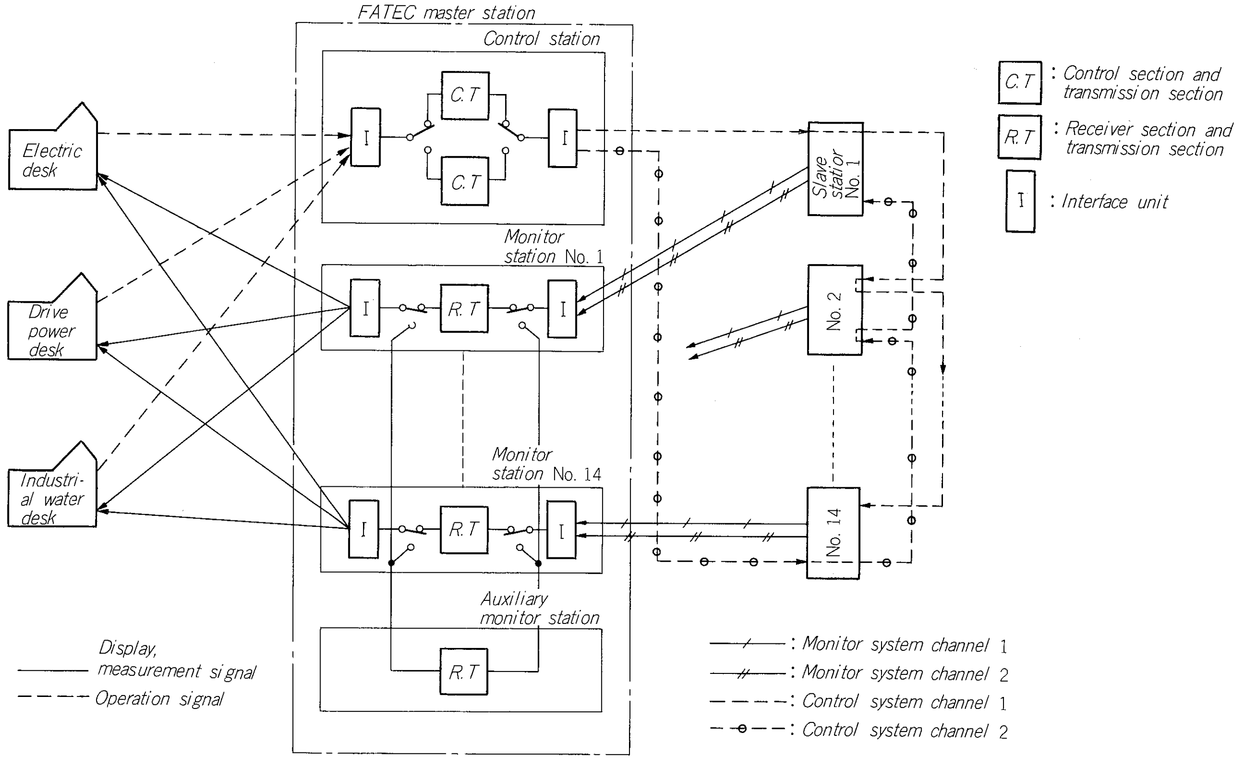

Fig. 9 System flow of FATEC 140

shutoff valve of the gas fuel equipment, for example. The direct control operation switches have a different shape so as to identify from the transmission system by the telemeter telecontrol unit.

3 Monitor panel and operation desk

The drive power monitor panel consists of the fuel, industrial water, air, oxygen, steam, drive power equipment air, and other blocks. A non-graphic panel system was adopted, except for the drive power equipment power supply. As monitor instruments, the shop working display, digital selection display, analog display, various controllers, recorders, etc. are arranged for monitoring in each system, as required. The operation desks are installed so taht they correspond to respective panels, and the telemeter telecontrol switch, selection indicator switch, ammeter, fault display, and telephone command functions are provided, respectively. These electric power and drive power panels and desks as well as their component units were arranged with due care based on the human engineering.

4 Interface unit

A sequencer is partially employed as an interface for operation signals and combined alarm signals out of the signals between the master station of telemeter telecontrol system and operation desks. This sequencer system is superior to the relay system about the following points.

- Reduction of manhours in design and test
- Improvement of reliability due to no-contact design
- Reduction of mounting space
- Easy change and extension of control contents

Major specifications of this sequencer are as described below.

Type	: SC-20
Control system	: Synchronous control system
Program system	: Stored program system
Arithmetic system	: Full-time repetitive operation
Program step	: Core memory 4,096 words
No. of input/output points:	Total 800 points/set

3) Computer control system

The computer system is divided into the drive power computer system and electric power computer system for convenience' sake in management.

Software is divided into (a) operation demand and supply control software for operation guide, such as energy demand and supply predictive control, appropriate distribution of fuels, decision of optimum generation output, monitoring of equipment systems, and (b) technical control software which is used for data logging in the form of hourly log, daily log, and monthly log.

(1) System configuration

Fig. 10 indicates the system configuration. PANAFACOM (PFU)-300 was installed as the main computer for energy center, and PFU-100 is assembled into the system by channel linkage for the purpose of linkage with the central computer.

(2) Computer functions

Fig. 11 indicates outline functions.

(3) Outline of software

1 Data logging

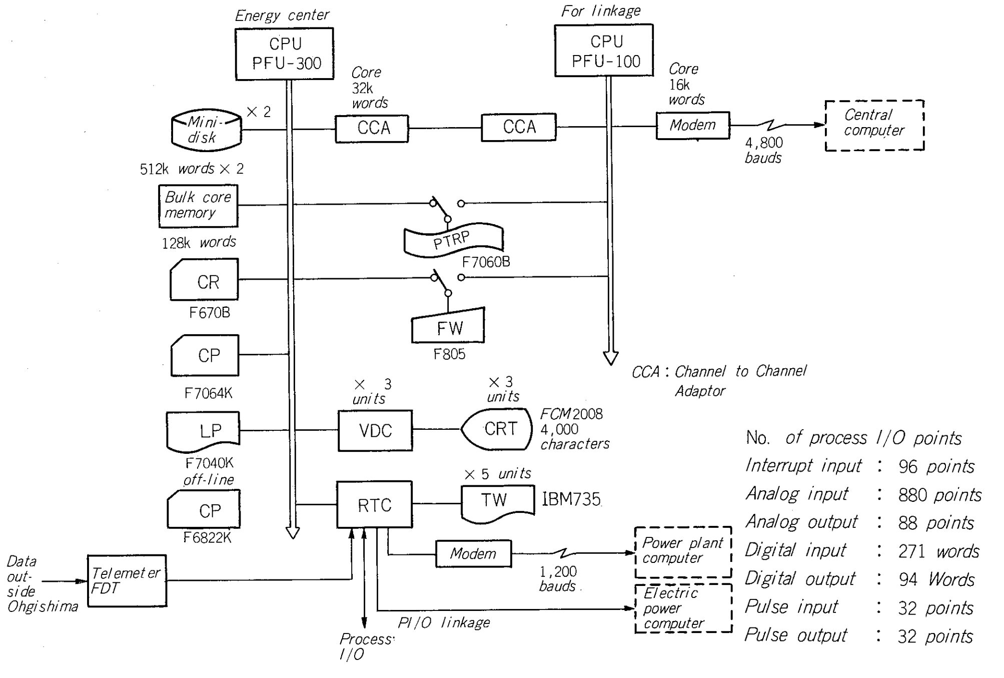

Fig. 10 Computer system configuration

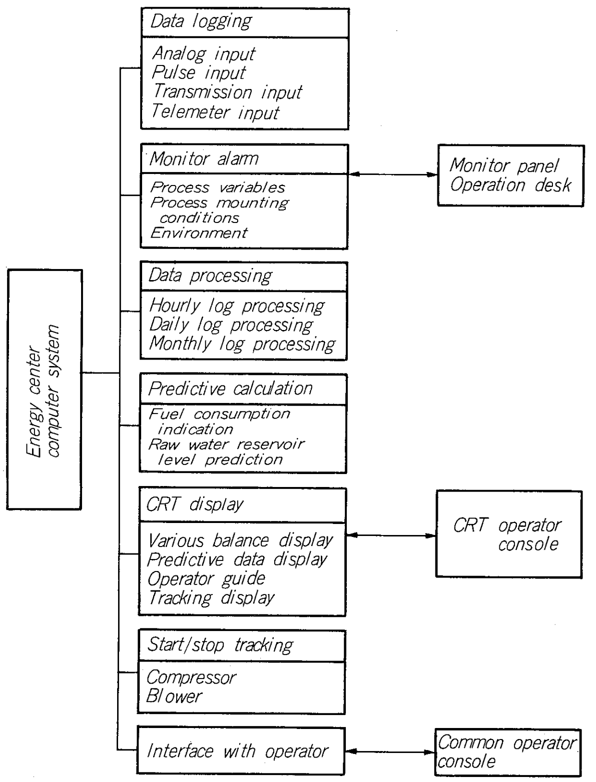

Fig. 11 Functions of computer system

Analog input, pulse input, data transmission using modem circuit, and telemeter data, are available as input data. The analog input data are scanned every minute, in principle. However, the gas generation quantity and monitor alarm objects are scanned at several tens seconds intervals. Pulse input is concurrently provided with analog input about the transaction quantity which requires accuracy in particular. The instantaneous value is an analog input, while the integrated value is a pulse input. In data transmission, power plant data are collected once every 1 minute, once every 2 minutes and once every hour. Data in the Mizue district are collected every minute by telemeter.

2 Monitor alarm

The monitor alarm is made from the monitor panel or CRT. Regarding the monitor alarm by monitor panel, an input selected by depressing a pushbutton is digitally displayed. The upper-level, lower-level, and lower/lower-level are checked in the input mode, and if a fault was detected, it is informed to the operator by lighting a lamp on the monitor panel and also by buzzer sounding. Regarding monitor alarm by CRT, the system balance pictures are displayed according to purposes, every gas, purification plant, compressed air, steam, etc., so that required data can be monitored as an intergrated format.

3 Data processing

Data processing can roughly be divided into the corrective calculation at data input time and the document generation by data integration. The corrective calculation comprises the correction by temperature, correction by specific gravity, correction by calory, broken line approximation, and calory calculation by gas combustion caused by furnace top generation.

4 Predictive calculation

The predictive calculation comprises gas holder prediction and raw water reservoir level prediction when the industrial water receive is interrupted. The gas holder level prediction results are reflected on the fuel consumption indications to the power plant. If the gas holder is predicted to reach the upper limit or lower limit, a corresponding change of the consumption quantity of gases is noticed to

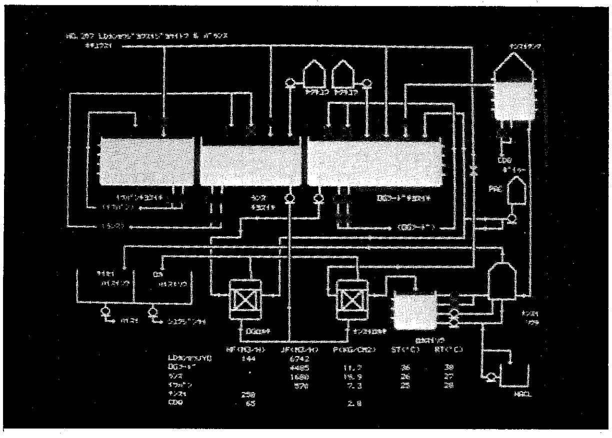

Fig. 12 CRT display (1), flow balance of water filtration plant

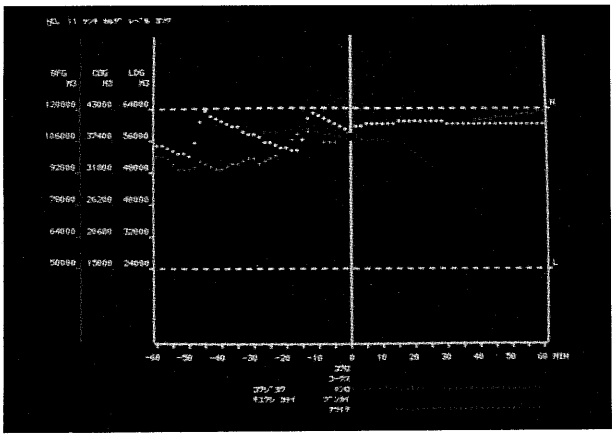

Fig. 13 CRT display (2), forecasting of gas holder level

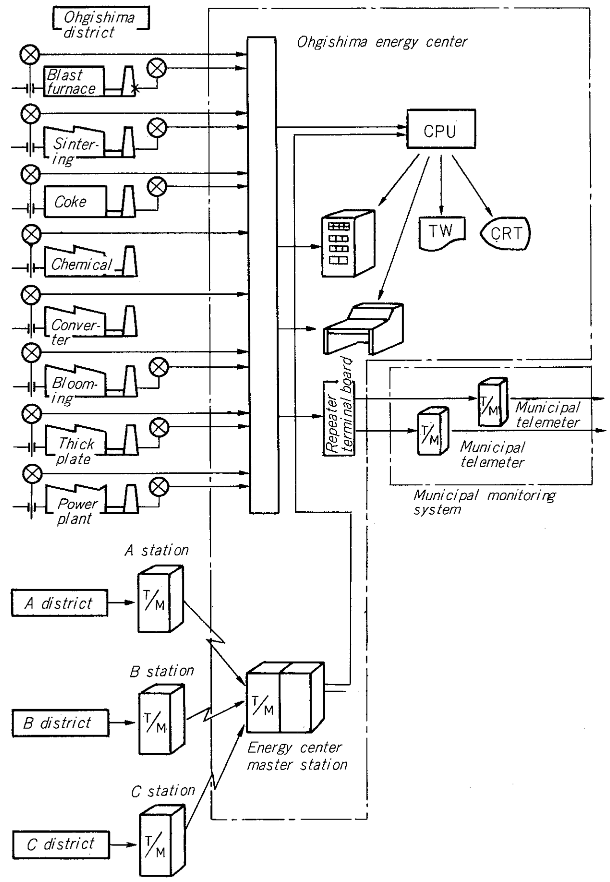

Fig. 14 Environment monitoring system flow

the power plant by means of data transmission. The raw water reservoir level prediction is made to simulate a change of the raw water reservoir level when the industrial water receive was interrupted or the industrial water consumption quantity at each shop was changed, and this predictive value is displayed by a graph as references for operation during water interruption.

5 CRT display

The CRT display comprises the monitor alarm, process control conditions display, predictive calculation results display, operation procedure display, start/stop sequence display, and display of indicating data to power plant, for example. *Table 4* shows the kind of CRT display, while *Figs. 12* and *13* indicate examples of CRT display.

Table 4. Kind of CRT display

Application	Fuel	Drive power	Industrial water	Total
No. of CRT display pictures	16	12	25	53

6 Start/stop tracking

The start/stop operation of gas blower and air compressor is composed of a series of operation, such as closing and opening of valves, operation and stop of auxiliary devices, etc. The progressive conditions of the operation sequence of these devices are traced by the valve and auxiliary device conditions, and displayed on CRT. The entire operation sequence is displayed on CRT, and also a color is changed about finished operation to indicate the arrival point of the sequence.

4) Environment control system

Fig. 14 indicates the environment monitoring system flow.

(1) Signals of combustion flow and exhaust gases SO_2, NOx, O_2, etc. of major facilities are collected to the energy center as environment monitoring data in the plant.
(2) In Ohgishima direct, these data are sent by the direct feed system of current signals via a measuring signal trunk route. In the A, B, and C districts, these data are transmitted by mounting the telemeter unit. (For specifications of the telemeter, see *Table 5*.)
(3) Data collected by the Ohgishima energy center are sent by the municipal telemeter as environment monitoring to the city.
(4) The environment monitoring is executed by observing the agreement concluded with the three-party conference consisting of Kanagawa prefecture, Yokohama city, and Kawasaki city. In order to accomplish resonable energy management, necessary data are collected

Table 5 Specifications of telemeter equipment

Type	FDT			
Transmission system	Cyclic time-division transmission			
Modulation system	Frequency shift (FS) modulation			
Synchronizing system	Frame sync.			
Code system	NRZ equal-length code			
Error detection	Parity, inverted double-scanning			
Transmission speed	1,200 bits/sec			
Transmission circuit	Exclusive circuit (2 circuits/opposition)			
Opposition system	1 : N (N = No. of transmitting stations)			
No. of transmitting stations	N = 3 (max. N = 62 is possible)			
Transmission capacity	Transmitting station	Analog	Contact	Total
	A station	16 quantities	2 quantities (24 points)	18 quantities
	B station	22 quantities	2 quantities (24 points)	24 quantities
	C station	10 quantities	2 quantities (24 points)	12 quantities
	Max. 27/station			

and analyzed to take a suitable measure, and if an emergency command was issued, a control measure is promptly taken.

5) Power supply system

Fig. 15 indicates the power supply system in the energy center. This is a high reliability system with duplicated and tripricated back-up systems, as illustrated.

(1) Power is received by 3 incoming systems consisting of 3 kV x 2 systems and emergency diesel power supply AC 210 V x 1 system.

(2) With the duplicated battery back-up system DC power supply provided as the base, a static CVCF system is adopted for the instrumentation and computer to assure a complete uninterruptible measure by the selection without momentary interruption, even if commercial power source was completely interrupted.

6) Communication system

The communication system was provided preponderantly for the purpose of efficient management of the energy center in its operation, maintenance, and systematic demand and supply control by a limited number of operators. This system consists of energy center telephones and radiotelephones in the energy center network for quick and accurate liaison service.

The energy center telephones are installed in the energy center, energy center equipment being scattered inside the plant, and each shop to assure close contact with related sections and also prepare for an emergency use.

A direct telephone was also installed in the power plant, blast furnace, oxygen center, etc., where a close contact is particularly required.

Major functions of this system are simultaneous command, group command, and communication between slave stations.

The radiotelephone system has the base station in the energy center, a mobile station in each patrol car, and a portable station in patrol staff, and communications can be done optionally from these stations.

No. of telephone installed:

(1) Energy center telephone: 100 stations
(2) Radio patrol car: 5 units
(3) Portable radio: 20 units

7) Trunk cables

The following trank cables are employed for signal transmission as the arteries of the energy center by taking various limitation conditions into consideration.

(1) General measuring signal: KPEV-S 1.25 mm^2
(2) Control display signals: CVV 1.25 mm^2
(3) Telemeter and telecontrol signals: KPEV-S 0.9 mm^2

8) Disaster-preventive management system

Ohgishima is located at a corner of the Keihin Combinert district. Since it treats gaseous fuels, heavy oil,

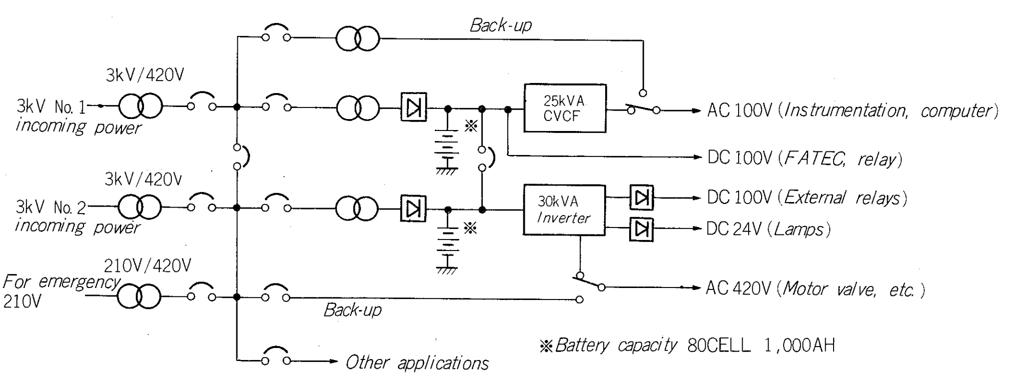

Fig. 15 Diagram of electric power supply

oxygen, etc. in large quantities as a specific condition of the steel making plant, an epoque-making disaster-preventive center as well as basic layout fire-fighting equipment were installed by fully considering disaster-preventive measures.

The plant is also designed as earthquake-proof according to objective equipment. The disaster-preventive center was installed at a place adjacent to the Ohgishima energy center as an integrated centralized control system of plant energies, so that an abnormal phenomenon can be treated quickly, if happened.

The disaster-preventive center consists of the automatic fire alarm equipment covering over the entire plant, various fire extinguishing equipment, centralized monitoring functions, such as momentary receiver of a break point of disasters, emergency broadcast system in premises, and radio command covering the entire plant premises, plus an exclusive fire fighting team equipped with chemical fire engines, ambulance cars, patrol cars, etc.

The fire alarm is also monitored from the repeater receiving panel in each shop, and the initial-stage fire fighting is made by the self-defence fire fighting team being organized in each shop as the duplicated fire-fighting system.

This center also serves as a communication center to public fire stations, if such an accident happened.

V. CONCLUSION

This paper introduced an outline and recent tendencies of the energy center equipment in steel making plant and the Nippon Kokan K.K. Ohgishima energy center as an embodied example.

The energy center is now being transferred as a direct control system for the purpose of keeping track of the production output of each process, generation quantity and consumption quantity of energies, and other variable in the online mode based on the production plan so as to realize the total cost minimum by reasonable management of various energies.

Accordingly, we will make an effort to fill up the energy center functions with improved reliability and high performance, and also develope a new instrumentation control system.