APPLICATION OF DATA LOGGER

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I. PREFACE

In this Article, the writer not specializing in Data Logger describes in a standpoint of users what attention should be taken when the user not specializing in general Data Logger too is going to adopt Data Logger into his own industrial plant, and takes actual examples of some representative industries as a reference. In order, fundamental subject will be described at first.

II. DEFINITION OF DATA LOGGER

For the due operation and management of various production plants such as power, steel mill, paper manufacturing, machinary, chemical etc., following processings are absolutely necessary.

1) Supervising the instant values of main points condition in plant, safe operation of the plant is conducted.

2) Recording the instant values of main points condition at a regular interval and recording the integrated values of such items as raw material quantity, consumed energy, production quantity, generated energy etc. in a regular duration, fundamental data for plant management are taken from the recorded values.

These processings are carried out even in an old-fashioned plant. For example, in the works watchman watches many indicating meters and takes due treatment when some of them comes to indicate off-normal value, or watchman reads the indication of indicating meters or integrating meters in a regular interval, fills up these values in recording sheets, calculates and records the sum of these values or efficiency etc. and makes operation diary. Managing plan is checked with the operation diary in a control department and proper suggestion are given to the works.

On the other hand, Data Logger performs the logging of operation diary automatically, and besides its computing ability and computing & logging ability, it may have off-normal monitoring ability by which off-normal condition of measured value can be always checked. The combination of these different abilities can produce different types of Data Logger.

Definition of Data Logger is not yet settled because it is now under development, but it can be generally said that Data Logger comprises the following kinds of logger.

1) Simple Data Logger

Data Logger in narrow sense, namely, it only records measured values.

2) Data Logger with off-normal alarm

It not only records measured value but has ability of checking the off-normal deviation from normal value. In case of off-normal condition, it can alarm or record the off-normal value. Different system of countermeasure against off-normal condition can be taken according to the types of machine.

3) Computing Logger

The two kinds of logger mentioned above can perform the multiplication by scale factor for each channel and the subtraction by standard setting value for detection of off-normal value. In Computing Logger, however, in addition to these simple computation for each channel, elementary rules of arithmatic can be optionally performed between different input channels and between different times, too. To make these computations, it is provided with a computing program device and a numerical memory device. There are different computing abilities from low to high, and a high level Computing Logger has nearly same computing ability as a general purpose computor. This Logger can be generally used for computing control.

The Data Logger with off-normal alarm can be used as a Monitor by eliminating the logging mechanism if data logging is not necessary while off-normal checking of measured value is important. In other words, the machine generally called as Monitor is same as the Data Logger with off-normal alarm in their main mechanisms. Therefore, we can say Monitor may be one of Data Logger, but it would be better to call Monitor because it has no logging function.

Since there is no clear definition of Data Logger now, the above classification is not necessarily correct, but in normal sense it would be most reasonable. It is important to note that the Data Logger with off-normal alarm can be used combining Monitors and Loggers optionally in its channels in accordance with the requirement of only off-normal checking, only recording or both off-normal checking and recording.

III. ABILITY OF DATA LOGGER

Ordinary Data Loggers have generally the following functions. However, not all Data Loggers have these functions, and specification is changed according to the machine's ability etc.

1) Instant values for various kind items and many points are numerically indicated on a typewriter at a regular interval.

2) For integrated value indication, an integrator is separately provided to send a pulse signal for each some integrated value, to count the number of pulse signals and to measure the sum of integrated value. The Data Logger receives the pulse signals and can calculates and prints the sum of integrated value in a regular duration.

3) Computation of designated subject in connection with the above-mentioned instant value or integrated value at a definite time is performed and its results are printed on a typewriter.

4) From the data of instant value or integrated value for each regular time, sum for several hours or hole day, tatal efficiency, maximum value, mean value, load factor etc. are calculated and printed on a typewriter.

5) When measured value deviates out of normal value, it can alarm and, if necessary, printing time interval is shortened to print the measured values in a short duration. Since it is convenient to separate the off-narmal printing from the regular time printing, different printing papers are used, i.e., another typewriter is exclusively used for off-normal printing.

6) It can print the measured value at an optional time by pushing a manual push button switch and can also indicate the measured value of some channel on a numerical glow tube.

IV. PROFIT BY USE OF DATA LOGGER

Application of Data Logger is the first step of automation of production control and produces the following profits.

1) Labour can be saved.

2) Instruments can be omitted to some extent. Perfect omission is difficult, but it is enough to provide only few instruments for change-over indication in case Data Logger is out of order.

3) There is no space to introduce human mistake and tamper, reading error according to individuals is eliminated, actuality and consistency of data are maintained and correctness of management can be expected.

4) Collection of data can be speeded up, therefore, rapid correction of plant management is conducted and plant efficiency can be increased. While, since the measured value of many points of plant can be obtained at the same time, judgement of plant operation is very easy.

5) Since the Logger indicates measured values in numeral, such troubles are eliminated that in case of analogue recorder, measured values are read through recorded curves and scale lines and the obtained measured values are applied to the next stage calculation.

Recently, automation of management becomes active, i.e., various raw data are collected, classified, calculated and regulated, from which various necessary data on management are correctly and rapidly obtained by means of machines to increase the profit of enterprises. Data Logger discharges the first duty of automation, and data obtained through Data Logger are led to the next stage punch-card system to produce the higher judging data of management and productivity can be highly increased.

V. ATTENTION ON APPLICATION

When Data Logger is going to be adopted, attention should be especially paid on the following points in addition to the ordinary check.

1) To select standard machine

You must select the type being most suited to your own plant from the standard types of experienced manufacturers. Since Data Logger is now under development, only few manufacturers settle their standard specification of Data Logger. Low cost, prompt delivery time and stable characteristics will be expected if you adopt the standard type machine of such manufacturers having already settled their standard specification and delivered many same products.

It will invite unfavorable result to both user and manufacturer to require the special type because Data Logger is highly developed automation machine and so much time and labour are required for newly designing, manufacturing and testing.

2) To select scanning speed

Data Logger converts the phisical quantity (analogue quantity) of voltage, current, temperature, pressure, flow etc. to the numerical quantity (digital quantity) and indicates them in numerals.

Therefore, it is provided with the apparatus converting from analogue quantity to digital quantity,

for example, converting from input voltage 5 volts to numerical signal 5. The signal corresponding to the numeral is sent to a typewriter and proper key action prints the numeral corresponding to input phisical quantity. This converter is called Analogue-Digital Converter or A–D converter. Each measuring item is not equipped with A–D converter, but different measuring points are transfered one by one to one A–D converter and printed in turn in order to reduce the cost. This transfer operation is called scanning and it is also necessitated by the fact that ordinary typewriter is a page printer which cannot print more than two letters at the same time. By extreamely increasing the scanning speed, it is possible to read the measured values of many points at the same time with a little time error. For example, for 100 measuring points, if scanning speed is 0.01 sec. per point, maximum time error between measuring points is 1 sec. However, in case of high speed, printing of typewriter cannot follow the signals. In such a case, measured values of each point after scanning are stored in the memory apparatus, then the contents of the memory apparatus are taken out in order matching to the printing speed of typewriter.

If scannings peed may be lower than the printing speed, the memorial apparatus as mentioned above is not necessary and direct printing through A–D converter is available, thus causing the apparatus cheeper.

If few typewriters are required because of many measuring points, by adopting the simple memory apparatus for each typewriting and by operating the typewriters in turn, the scanning speed limited by typewriter's speed becomes in inverse proportion to number of typewriters, thus higher scanning speed is obtained.

A–D converter is generally classified into two types, i.e., electronic self-balancing servo-mechanism system equipped with a code plate and totally electronic system (using transistors). The former requires convertion time of 0.5 sec. which limits the scanning speed to low level, but the latter has conversion time of less than only few ms which is out of question except in case super high speed of scanning is required. After all it is important to study the necessary scanning speed considering plant characteristics and using purpose of Data Logger and to select the economical Data Logger which will suit to the scanning speed.

3) To consider calculation ability

It is uneconomical to use the Data Logger having higher calculation ability than needed. It is important to select the standard type of Data Logger having the calculation ability being suited to reguired condition.

4) To note the connection with transmitter

Electrical signals from transmitters of temperature, pressure, flow etc. not necessarily match to the standard electrical signal of receiver input, especially in case the transmitter and the logger being made by different manufacturers. Therefore, the signal matching is positively necessary.

5) To note the non-linearity of transmitting signal

For example, thermo e.m.f. of thermocouple etc. changes in non-linearity against temperature, while A–D converter converts the measured values to numerals in linearity. In this case, printed numerals do not indicate correct values if they are simply connected.

It is necessary to check the provision of linearizing apparatus or to check the non-linearity rate of transmitting signal. In case of ordinary instrument, this becomes out of question by scaling the graduation corresponding to signals. But in case of Data Logger this problem cannot be easily settled.

6) To note the ripples of transmitting signal

Since scanning time for one channel of Data Logger is generally very short, when transmitting signal has ripples, Data Logger equipped with a high speed A–D converter prints different values according to the scanning moment. Ripples are generally generated by inherent character of transmitter, induction disturbance etc. Filter is required to avoid the measuring error caused by ripples, but it complicates and costs more to set the filter in each channel. If a filter is provided to the input of A–D converter in common, transient phenomena appear every moment of change-over of scanner and it becomes necessary to start converting action after the transient phenomena attenuate to some extent, thus causing the scanning speed low. If each channel is equipped with a filter, above-mentioned trouble does not occur instead of high cost. It is necessary to determine the Data Logger considering totally the ripples in transmitted signal, the time constant of filter and the required scanning speed.

7) To note the total measurement accuracy

Generally A–D converter has high accuracy (error ca. 0.1%), while transmitter has rather much error. The printed value of Data Logger has the total error comprising transmitter's error and logger's error. If signal converter, non-linear compensator or filter is put between transmitter and logger to match transmitted signal and standard input signal of logger, error produced in these apparatus is added. In other words, if total error is allowed to a certain extent, the above-mentioned signal converter etc. are allowed to have larger error, causing easier manufacturing of converters. When total measuring accuracy is reguired to be strictly high, number of channels provided with an exclusive signal converter increases, causing higher cost. These things come into question especially in case Data Logger is newly

settled in the already established plant.

The total measuring accuracy allowable to actual use should be studied.

VI. OPERATION PRINCIPLE OF DATA LOGGER

The operation principle of our standard Data Loggers type FIDAP 100 A and 100 B is explained below.

Fig. 1 shows the principle block diagram of FIDAP 100 A.

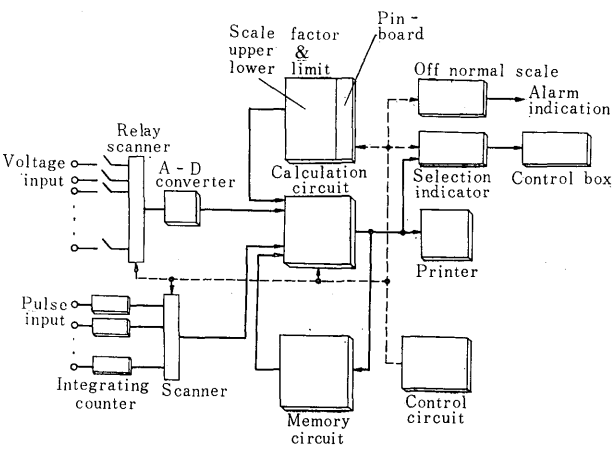

Fig. 1. FIDAP 100 A block diagram

Output of various transmitters are sent to the Logger as DC voltage in proportion to measured value or puls per setteled unit integration of measring value.

In this Logger, to connect the input voltages to a A–D converter, they are scanned by an input relay scanner and analogue inputs are converted to numerals (digital). Since the output of A–D converter is indicated in % of decimal system in 3 figures, compensation to actual measured value is necessary.

To make this compensation, the scale factor set on a pin-board is taken out as a scanning signal synchronizing to the input scanner, and the input converted by A–D converter is multiplied by the scale factor in a calculating circuit. By subtracting this value from the upper limit and lower limit value set on the pin-board, measured value is checked and if it deviates from set range, the Logger alarms. These operations are repeated for each channel to keep constant supervision.

When control circuit receives signal of set time (one hour), set time printing of compensating value is also made, while, in the integrating counter of input, number of pulses in one hour is counted for each channel and counting value of some channel is led to the computing circuit by the scanner when set time signal is required.

Then, the counting value is multiplied by the same scale factor as the case of analogue value, and printing is carried out. This value is accumulated in the memory circuit of each channel to use for the calculation of total sum during 8 hours or 24 hours. After duration of 8 hours or 24 hours elapsed, integrated value is taken out from the memory circuit and the sum value for 8 hours or for 24 hours is printed or the mean value can be also printed by dividing the total value by 24.

These control is performed in accordance with the pre-set program.

The operation principle mentioned above is for type 100 A. For type 100 B, only pulses are available as input and other operation is same as that of type 100 A.

The block diagram of type 100 B is shown in Fig. 2.

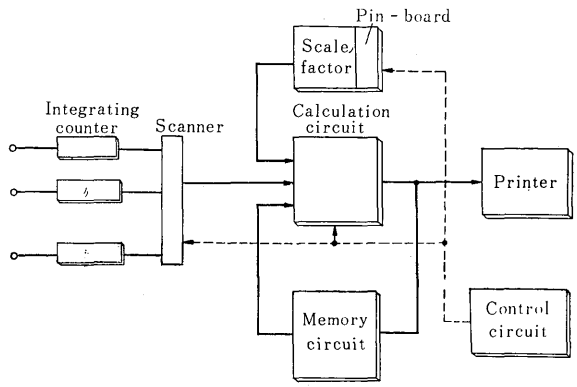

Fig. 2. FIDAP 100 B block diagram

VII. OUR STANDARD SYSTEM FOR APPLICATION AND OUR STANDARD TYPE DATA LOGGER

Our standard system is explained regarding the connection system with transmitter and the total measurement accuracy which will especially come into question when Data Logger is applied to some plant. Then, various specifications of our standard type Data Logger are explained.

1. Connection System with Transmitter

There are various kinds of transmitting signal according to the kind or type of transmitter, manufacturer of transmitter etc. In this paragraph, connection of Data Logger with electrical signal converted from pneumatic pressure, displacement, differential pressure etc. by pneumatic-electric converter or ring-tube is taken into consideration. As an electrical signal there are various kinds, for example, signal of 0～5 A for AC current, 0～50 mA for our TELEPERM transmitter and 0～x mV for thermocouple in

which x is changed according to measuring range. And, in some case, signal has non-linearity against measured value.

As far as Data Logger treats these various kinds of transmitting signal, standard Logger cannot be established.

Therefore, our Company standardizes the following points.

1) Input signal of Data Logger is standardized to be DC 0～250 mV, and the transmitting signal which does not match to this should be converted by an input signal converter.

2) This input signal converter is also standardized and the standard type being suited to the transmitting signal should be selected.

3) In case of high level computing logger, non-linearity compensation of signal can be treated in logger itself. But in case of standard Data Logger, as the number of channel having the conpensation ability in Logger is limited, a converter of non-linearity compensation is added as standard. This converter is also standardized.

4) Filter is provided in common. If signal has larger ripple than the allowable ripple of common filter, an exclusive filter is provided to the channel. Actually, the channel necessitating an exclusive filter is very few. For the channel much influenced by induction disturbance, wire and cable should be shielded. The common filter is provided inside Data Logger as standard and the filter's error is, of course, included in the total error of Logger $\pm 0.2\%$.

2. Total Measurement Accuracy

So far, the measurement accuracy of instrument was generally defined for individual instrument such as transmitter, receiving meter etc. and it was very rare that the total measurement accuracy came into question. Data Logger is, in some case, equipped with signal converter for signal level matching, non-linearity compensation or ripple elimination etc., and sometimes question rises on the comparison of total measurement error between the case compensation is treated for non-linear signal and the case it is not treated. The compensation would be not necessary if it has little effect, and conpensating error of converter by which non-linearity is compensated should be also taken into consideration. Since the converter for signal level matching is frequently used for Data Logger, the standard on which the conversion accuracy is decided should be thoroughly considered.

As a standard of judgement for these problems, our Company adopts the following formula.

1) Total measurement error is defined as follows.

$$\delta = \sqrt{\alpha^2+\beta^2+\gamma^2} + \alpha' + \beta' + \gamma'$$

where α: Probability error of detecting element against measured object (hysterisis, unevenness of product, looseness etc.)

α': Non-linearity error of detecting element

β: Probability error of signal converter between input and output signal

β': Non-linearity error of signal converter between input and output signal

γ: Probability error of Data Logger

γ': Non-linearity error of Data Logger

δ: Total measurement error

In case the detecting element is multiple one, errors of detecting element α and α' are defined as follows if it is the multiple detecting element of 3-element series.

$$\alpha = \sqrt{\alpha_1^2+\alpha_2^2+\alpha_3^2}$$
$$\alpha' = \alpha_1' + \alpha_2' + \alpha_3'$$

The figures of 1, 2 and 3 are corresponding to the error of each element.

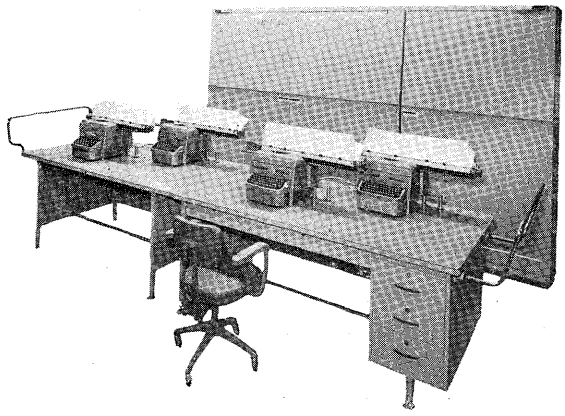

Fig. 3. Data Logger, type FIDAP 100 A

We are deciding the measurement accuracy in such a policy that the standard type converter having small error and being economical is selected, total accuracies are calculated by the above formula, table of total accuracies is made, total errors in the ordinary measurement system are also listed, then adoption or cancel of non-linearity compensation is decided considering both the customer's requirement for total measurement accuracy and the table of total measurement accuracy made by the above-mentioned way.

3. Our Standard Type Data Logger

The fundamental specification of our Data Loggers which are completed as standard type is described below. In this column, only transistor system Loggers are introduced though there are other standard types of relay system.

Type FIDAP 100 A, FIDAP 100 B

As a standard type for plant, having high calculation ability, rapid scanning speed and many input channel, we have developed type FIDAP 100 A which can receive both analogue input and pulse input. The Logger neglecting analogue input from type FIDAP 100 A is type FIDAP 100 B which is mainly used as an integrated value logging apparatus.

Printer : (27-in as standard) 1～4 sets

Number of input channel :

Type 100 A	voltage input	max. 150
	pulse input	max. 96
	both input	max. 200
Type 100 B	pulse input	max. 192

Input voltage : 0～250 mV in full scale

Conversion accuracy for input voltage : less than ±0.2%

Self-check : For every cycle of scanning, fixed voltage is measured to make self-checking.

Pulse input : 0～399 pulses/hour

Scanning speed : 0.3 sec./channel

Change-over of input order : Possible by replacing the plug in the input change-over plate.

Setting of scale factor : Set on the pin-board in decimal system in 3 figures.

Setting of upper and lower limit value : Set on the pin-board in decimal system in 3 figures. (only for type 100 A)

Setting of computation process for each channel : Kind of conputation process (15 kinds) is set on the pin-board.

Setting of constants : Set on the 10-figures dial plate in decimal system in 3-figures.

Setting of computation program : Set on the program setting plate. Memory apparatus has capacity of approx. 400 words. Since computation process is conditional in circuit, it is necessary to determine the measuring range for each logging system and the number of figures etc.

Off-normal alarm (for type 100 A) : When measured value deviates out of set limit, i.e., in off-normal condition, bell alarms and contact for lamp corresponding to the fault point is made.

Number of printing items :	max. 200 items
for one printer	max. 50 items
number of printers	max. 4 sets

Printing speed :

1.2 sec. per item for one printer

0.3 sec. per item for 4 printers

Set time printing : For voltage input, i.e., for instant value, change-over between 10 min., 20 min., 30 min., and 60 min. can be made on the control panel. For pulse input, only 60 min. is made.

Off-normal printing : Off-normal printing is made only for instant value.

Only the printer in charge of off-normal item operates and prints the all instant values in connection with the off-normal value. In this case, the off-normal value is printed in red and marked with *.

Short duration for off-normal printing can be selected on the control panel as 2 min. or 5 min.

Printing at optional time (for type 100 A) : Printing at optional time can be made by pushing the push button switch on control panel to send signals to the optional printer, except during off-normal printing or regular printing. The optional printing is only made for voltage input.

Number of printing figure :

Instant value...3 figurs

Integrated value, one hour value...3 figures

Integrated value, sum value for 24 hours...5 figures

Printing of mean value and sum value : Mean value is $^1/_{24}$ of sum of recorded value for every hours.

As integrated value, one hour value, 8 hours value (or 6 hours value) and sum value for one day are printed.

Indication on control panel (for type 100 A) : Each instant value can be read on the numerical glow tube by selecting dials.

Type KM-D 50

This was doveloped as a simple Data Logger. Input is limited to only analogue quantity, number of channels is up to 50 and A-D conversion is made for each scanning of one channel then printing is made, thus scanning speed is fixed by typewriter's speed. Since the scanning speed is very slow, memory apparatus is not necessary, elementary rules of arithmetic except scale factor multiplication is neglected, and cost is much reduced.

Input :

Number of channels	50
Kind	Analogue quantity
Voltage	0～250 mV (at full scale)

Accuracy : Error of printed value against input voltage is less than 0.2%

Scanning speed : 1.2 sec/channel

Setting of scale factor : Decimal in 3 figures, digital system.

Setting of upper and lower limit : Decimal in 3 figures, digital system.

Printing : Only regular printing. Setting of duration is made by change-over device to 10, 30 and 60 min.

Printing speed is same as scanning speed.

Supervision : Measured values are constantly supervised.

Off-normal indication : When off-normal occurs, bell alarms and lamp indication of off-normal channel continues up to recovery.

Selective indication of measured value : Optional channel is selected by manual setting and measured value can be indicated in a numerical glow lamp.

VIII. APPLICATION TO VARIOUS INDUSTLIES

Data Logger can be applied to various industries by changing the measuring items and data processing items accordingly.

The leading industries such as thermal power plant, hydraulic power station, substation, central power supply station, chemical plant, steel plant, paper plant etc. are rising their operation efficiency by adopting Data Loggers.

In huge industrial plant, powers of generation, transmision and distribution and fuels of coal, gas, oil etc. raw maturials of coal, lime, oar, wood etc. are complicatedly combined to make a whole plant.

As a managing system of such a plant, following systems are generally taken out.

1) Local management
2) Central management

Local management is conducted at works for each group of machinery equipment and is to control directly the machinery operation or the machinery proper.

Central management is not to control locally, but to control the management of whole plant.

In other words, raw material consumption, power consumption, production quantity etc. of whole plant is taken, and plant efficiency cost accounting etc. are to be studied.

Data Logger should be suitably selected according to its purpose, i.e., for local management or for central management.

For local management, major function of Data Logger is instant value recording and off-normal checking, to which efficiency calculation of plant and integrated value measurement etc. are added. On the contrary, in case of central measurement, major function of Data Logger is integrated value measurement to obtain the plant efficiency and cost etc.

As the place where central management is conducted, power plant has central supply station and industrial plant has energy center in which raw materials, fuel and power are controlled.

Examples of the Data Loggers supplied together with plant equipment by our Company are shown below. Only outline of specification of Data Logger is explained, neglecting the details of plant.

1. Turbo Generator & Blower Plant (for Steel Mill)

This plant comprises few sets of boiler and turbine. The turbine is used for turbo generator and turbo blower.

The following subjects are performed by Data Logger.

1) Boiler

Logging of boiler operation diary and off-normal checking is conducted.

Recording item number is maximum 47 and these items consist of analogue quantity approx. 40, integrated value approx. 6 and efficiency 1.

For analogue quantity, off-normal checking are also provided.

The main measuring items are pressure, temperature, flow and integrated flow of steam system, water supply system, air system and fuel system.

For fuel, measurement are made on B-gas, C-gas and fuel oil, respectively.

In addition, pressure and temperature of exhausted gas, gas holder level, O_2 composition of supply water, pH of boiler water and room temperature are also measured.

Main calculation is as follows.

(1) Enthalpy is calculated from steam pressure and temperature, and generated steam energy is calculated from the enthalpy and integrated flow.

On the other hand, supply water energy is calculated from supply water temperature and integrated flow, by which the generated steam energy is subtracted. By dividing this value by fuel energy, boiler efficiency can be calculated. These measurement and calculation are carried out for each measuring time.

(2) Sum value for one day is measured to get the mean value and integrated value.

2) Turbine

Logging of operation dairy and off-normal checking are conducted.

Number of recording items is 25 for one turbine.

The main measuring items are pressure, temperature and flow of each stage steam, pressure and temperature of extracted steam, pressure and temperature of condensing water, temperature and flow of supply water, pressure and temperature of oil, generator load, electrical conductivity of supply water and efficiency etc. This Data Logger is for local management as in the case of boiler, and most of measuring items are analogue system.

Main calculation is for turbine efficiency and sum and mean value for one day of each measured value.

3) Turbo Blower

22 measuring items are recorded for one turbo blower as in the case of turbine.

Pressure, temperature, flow etc. of steam system,

oil system and air system are recorded, and turbo blower efficiency is calculated. Furthermore, sum value and mean value for one day are also recorded.

2. Energy Center (for Steel Mill, Metal Co., Gas Co., etc.)

Data Logger for energy center is used as a central management, and only integrated values are applied in most cases.

Taking actual example of gas plant, all of 48 measuring items are integrated value or calculation result of integrated value.

The main measuring items are to perform every hours the following records for B-gas and C-gas etc.

(1) Integrated value recording of gas consumption of respective factory.

(2) Integrated value recording of gas production of gas generating apparatus.

(3) Recording of tatal consumption and total production.

(4) Calculation of loss and efficiency.

In the process of these recording and calculation, compensating calculation of flow against the change of gas density and temperature is performed, if nessesary. In addition, sum value and mean value for one day are recorded.

In case the plant is provided with pure gas generating apparatus other than B-gas or C-gas, cost calculation recording is of cause needed. We have experienced in the application of Data Logger to oxygen generating plant.

As an example of electric power system, power comsumption of each factory and its sum for each block etc, are recorded every hour, and total sum, mean value, maximum value, load factor etc. are calculated.

3. Substation and Switching Station (for Power Co.,)

An example of data sheet of Data Logger delivered to a super high tension switching station is shown below.

This is fairly simple because all items are integrated value. For power system, central management is thought to be classified into two kinds, local central management and central management, and the former is conducted in switching station or in local power supply station.

In most cases, only integrated values are applied as measured items.

Power Diary

Item / Time	Maruyama line (up) Normal MWH	Maruyama line (up) Normal MVH	Maruyama line (down) Normal MWH	Maruyama line (down) Normal MVH	Mihoro line (#2 L) Difference MWH	Mihoro line (#2 L) Difference MVH	Seki, Nagoya line (#2 L) Normal MWH	Seki, Nagoya line (#2 L) Normal MVH	Seki, Nagoya line (#2 L) Reverse MWH	Seki, Nagoya line (#2 L) Reverse MVH	Nishi-Nagoya line Normal MWH	Nishi-Nagoya line Normal MVH	Nishi-Nagoya line Reverse MWH	Nishi-Nagoya line Reverse MVH	Normal MWH	Normal MVH	Reverse MWH	Reverse MVH
01.00																		
02.00																		
03.00																		
04.00																		
05.00																		
06.00																		
Sub-total																		
07.00																		
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21.00																		
22.00																		
23.00																		
24.00																		
Sub-total																		
Sum																		
Mean value																		

Fig. 4. Example of data sheet

IX. CONCLUSION

Data Logger will be increasing applied from now on. Our Company has already established the standard specification and delivered the greatest number of Data Loggers in Japan. Though it is not so long since Data Logger is actually used, we have the following supply experience of the standard type transistor system Data Logger, which evidences that the standard specifi cation is completely established and it is reasonable.

FIDAP 100 A 6 sets (for steel, power, chemical plant)

FIDAP 100 B 5 sets (for steel, metal, power plant)

(up to April, 1961)

We hope users will increasingly adopt Data Loggers by which plant efficiency will be much improved. Though we have also supply result of many relay system Data Logger, it is omitted in this Article because transistalized Data Logger will be mostly required in future in place of relay system.

The standard system and application of Data Logger for high level calculator control other than ordinary Data Logger will be described in anothre volume.