

# FUJI TOTAL MANAGEMENT SYSTEM FOR WATER AND SEWAGE WORKS

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## I. INTRODUCTION

The advances made in water and sewage works technology in the last ten years have been amazing. The progress made in electric and instrumentational technology has gained special attention because the expansion of waterworks needs and the electric and instrumentational seeds have been so perfectly matched. Water and sewage works management has increased in space, time, and scale as evident in the increased management range in space seen in the larger size, greater complexity, and expanded coverage of water purification plants and sewage treatment plants, the expansion of data management time-wise by computerization of hydrologic statistics, and expansion of the business range from control to management and from facilities control to management information. Drought countermeasures, water pollution, energy saving, and other new problems will be added to these in the future.

On the other hand, electric and instrumentational technology has met the needs of waterworks with electronic instrumentation systems, advanced digital technology centered about the computer, advanced transmission technology centered about telemetering and telecontrol systems, and the appearance of man-machine systems typified by the CRT display. At the same time these new hardware appeared, advances were also made in the accumulation of water and sewage works software and systematization of large water and sewage works management systems became possible. Then the microcontroller appeared and the multiloop controller with microprocessor distributed system was introduced. After that, the single-loop controller appeared and a hierarchical system configuration from a large sized computer to single-loop controller was realized and a water and sewage works management system was completed. Since then, the construction of a water and sewage works system perfectly matched to the waterworks facilities by skillful combination of these system components has become important. The Fuji water and sewage works management system FAINS (Fuji Aqua Information System) series incorporating the latest technology is introduced.

## II. MANAGEMENT SYSTEM CONFIGURATION

Water and sewage management systems can be classified by management objective, scale, and management functions.

The management objectives can be classified into inside and outside facilities, and facilities and management business.

Generally, the scale is considered to be classified into  $3 \times 10^4$  m<sup>3</sup>/d or less,  $10 \times 10^4$  m<sup>3</sup>/d, and  $30 \times 10^4$  m<sup>3</sup>/d or over.

The management functions are classified into process control, system control, comprehensive control and management information system and include all the functions from sensor base to data base.

The Fuji water and sewage works total management system FAINS Series has three configurations-total management information system and include all the functions from sensor base to data base. shown in *Fig. 1* and *Table 1*.

The supervisory and control system is used for inside facilities i.e. mainly water purification plants and sewage treatment plants. These plants have the water refining process and water cleaning process. The objectives of control are physical sciences and microorganism processes. Process control and system control are the main functions and instruments, controllers, microcontrollers, and minicomputers are the main components.

The centralized-control system supervises and controls outside facilities. It is a water-intake and driving channel, main piping, sewage main line and pumping stations and distributing reservoir control system. This is the water conveyance process and is a simple physical process. Its main functions are system control of multiple piping networks and pumping stations. Its main technology is transmission technology centered about telemeter and telecontrol systems.

The total management system manages the inside and outside facilities as a total system. Therefore, it includes process control, system control, comprehensive control and management and is operated by a computer network centered about control computers. Water distribution control

Table 1. Application to water and sewage works of management system

Waterworks management system			System scale	Sewage works management system		
Supervisory and control system	Centralized system	Total management system		Total management system	Centralized control system	Supervisory and control system
		Management and regional water-works facilities comprehensive control	SYSTEM 600	Management and regional sewage facilities comprehensive control		
	City waterworks comprehensive control	Regional water-works facilities comprehensive control	SYSTEM 500	Regional sewage works facilities comprehensive control		
Large scale water purification plants decentralized control	Water distribution control	Large-scale water purification plants control and water distribution control	SYSTEM 400	Large-scale sewage treatment plant decentralized control and influent sewage control	Influent sewage control	Lage-scale sewage treatment plant decentralized control
Medium-scale sewer water purification plant control	Centralized control of water source, pumping stations, distributing reservoirs, and others at control center	Medium-scale water purification plant and outside facilities control	SYSTEM 300	Medium-scale sewage treatment plant and outside facilities control	Contralized control of relay pumping stations and others at control center	Medium-scale sewage treatment control
Small-scale water purification plant control by data logger and CRT	Centralized control of small-scale waterworks by data logger and CRT	Control of small-scale water purification plant and outside facilities by data logger and CRT	SYSTEM 200	Control of small-scale sewage treatment plant and outside facilities data logger and CRT	Centralized control of small-scale sewageworks by data logger and CRT	Control of small-scale sewage treatment plants by data logger and CRT
Small-scale water purification plant, pumping station, and distributing reservoir supervision and control	Centralized control of small-scale waterworks	Small-scale water purification plant and outside facilities control	SYSTEM 100	Small-scale sewage treatment plant and outside facilities supervision and control	Centralized control of small-scale sewage works facilities	Small-scale sewage treatment plant and relay pumping stations control

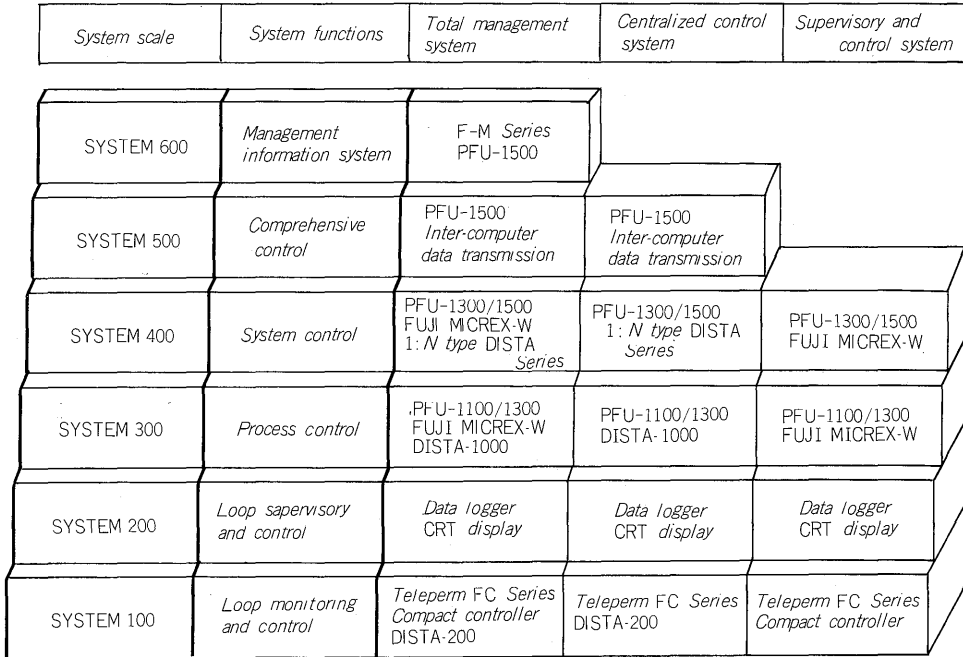


Fig. 1 Classification of manager system

systems centered about a water purification plants, regional waterworks system, and regional sewage works systems that management several main lines centered about a sewage treatment plant correspond to this system.

### III. SYSTEM CONFIGURATION

The system configuration of the three control systems is based on the centralized supervisory and decentralized control concept and is a hierarchal configuration with process control occupying the lowest position, followed by system control and comprehensive control occupying the next higher positions, and management information system occupying the highest position.

#### 1. Hardware configuration

Various hardware corresponding to the hierarchy system configuration is available. Fig. 2 shows the hardware. These hardware are connected by a transmission system and feature a smooth flow of information by both hardware and software.

The FACOM-M Series and PFU-1500 correspond to the management information level, the highest level. The PFU-1500 corresponds to the comprehensive control level. The PFU-1300 corresponds to the system control level and constitutes a medium-sized computer system. The PFU-1100 corresponds to the process control level and constitutes a small-sized computer system. All these systems have a so-

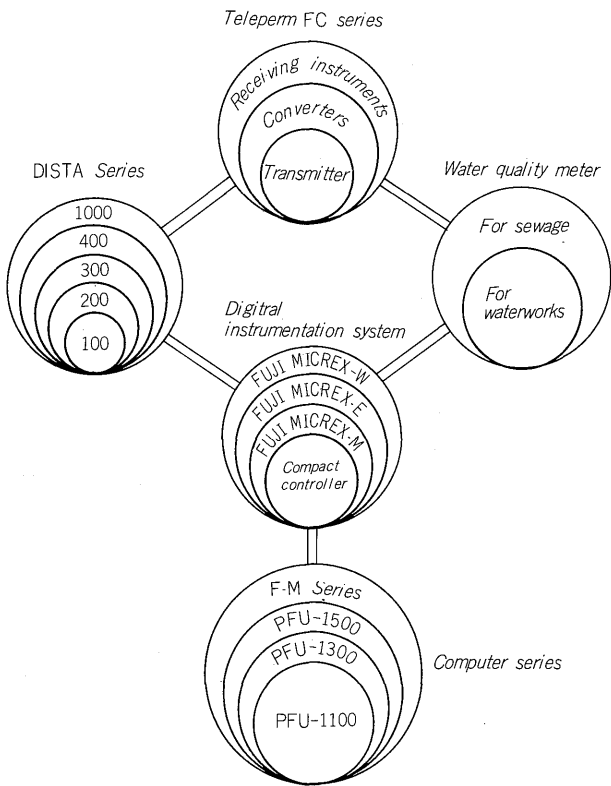


Fig. 2 Hardware of management system.

called control computer, minicomputer base system configuration. Data transmission between computers is performed through a MAXS system and dataway MPCS system.

The FUJI MICREX-W microcontroller system is available as a system control and process control low level system. This system is used at inside facilities units in 32 (or 16) loops units at water treatment plants. A decentralized control system is constructed by combining minicomputer that share the system control load. In medium-scale facilities, a process control level digital instrumentation system is formed by using it as a stand-alone system.

A microcomputer applied single-loop controller has appeared as a low level system in addition to the microcontroller system. This controller incorporated as a compact controller so it can be used as a loop units digital controller. This is extremely effective in automating small-scale waterworks and scattered waterworks facilities. These microcontrollers and minicomputer systems are connected by a DPCS microdataway system and data transmission is performed unerringly. Flowmeters, level meters, water quality meters and other teleperm FC Series and IS Series instrument are distributed at the minicomputer and microcontroller terminals as sensors.

#### 2. Software configuration

The software configuration has also been serialized under a unified concept corresponding to the hierarchal hardware configuration of the water and sewage works management system.

Fig. 3 shows the software configuration of the computer system. POPS, which stresses real-time capability, is available as process control system package software based on a basic software OS (Operating System). Application software suited to water and sewage works processes is furnished and has been standardized as a water works software package (W-TCS) and sewage works software package (S-TCS) by using these basic software. If these are made standard packages as an entire system, the flexibility as a computer system will be lost and cost-performance may deteriorate. Therefore, Functional packages and programs at the functional module level have been standardized. These packages and programs are MOPS for total management of water and sewage works information, PUCS for normal operation and control of facilities, and OCS for optimized control of facilities. Support tools, software development standards, etc. are available for software preparation assistance for smooth work at the same time these software are furnished.

The FUJI MICREX-W microcontroller system has standard packaged software for control, display, recording, and transmission. A special feature of this system is the availability of complete control packages for waterworks and sewage works facilities.

The compact controller and teleperm digital calculator utilize the special features of the microprocessor so various control functions and operation functions, as well as convention PID control, can be easily programmed from the operator panel.

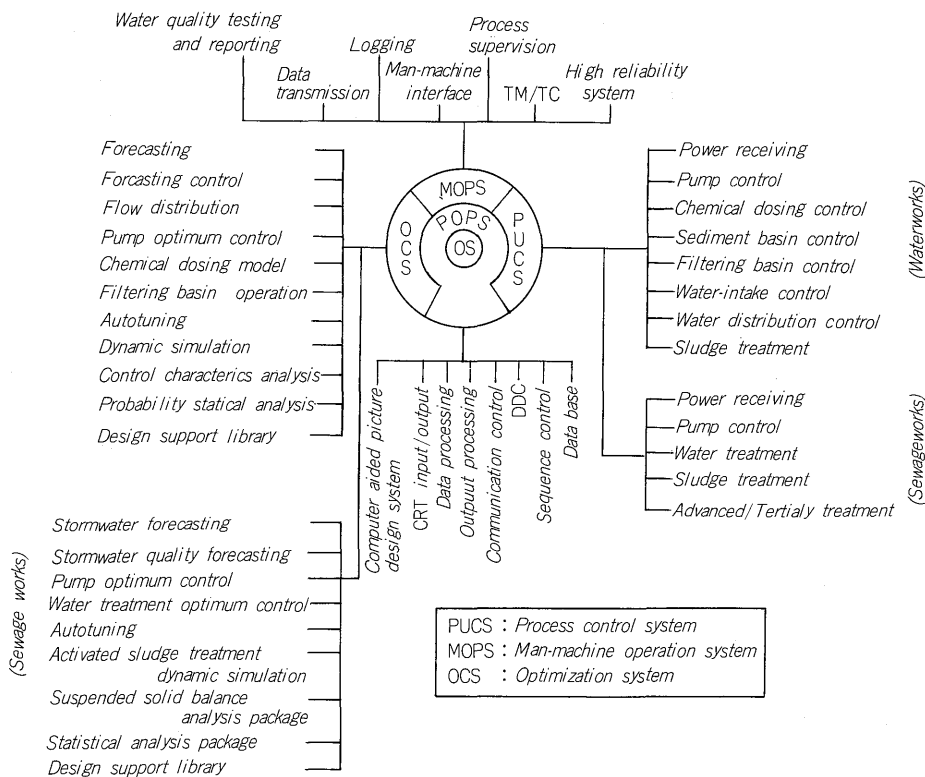


Fig. 3 Standard software  
W/S-TCS

#### IV. CONCLUSION

The newest water and sewage works management system has been introduced. Refer to the following reports for more details. The introduction of microcontroller in instrumentation technology has had an extremely large impact on the name of digital instrumentation. At the same

time, there is a feeling that the low side of instrumentation has been noticeably filled out. Especially, the single loop controller has pushed this. It can now be said that system configuration is complete. However, its functions will be further advanced and improved centered about the micro-controller and future developments wil strees improvements in the properties of the management system. There is still much room for growth. Instrumentation technology is expected to advance in the future.