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Lifeline Information Management System*

Takeshi Koike** Toshio Imai*** Tadashi Teramoto****

1 Introduction

The lifeline information management system serves to speedily solve problems that occur in the maintenance and management of pipeline facilities. It is a computer system composed of a system for processing an immense volume of information on pipeline and maps of their surrounding areas and a support system. With this management system, it is possible to perform more sophisticated maintenance and management of pipeline facilities with higher efficiency than before and to rationalize daily works associated with these maintenance activities.

2 Outline of System

2.1 Functions

The system is composed of a basic system for preparing, editing, updating and retrieving data bases of graphic and attribute information and an application system for support activities, such as analyses and simulations, using these databases. The functions of the system can be summarized as follows:

(1) Preparation and updating of maps and graphic and attribute information on pipelines.
(2) Retrieval and output in image and document form.
(3) Various analyses and simulations.
(4) Support in event of disaster or accident.
(5) Prediction and analysis of corrosion, leakage, and risk.

2.2 Field of Application

This system can serve underground pipeline networks of water pipe, gas pipe and electric cables, generally called lifelines, and can be applied to the following activities related to the maintenance and management of these pipeline facilities:

(1) Daily Maintenance and Management Activities
- Management (updating and storage) of drawings and ledger books.
- Output of management charts and related documents.
- Preparation of materials in the office.

(2) Activities Related to Construction Work, Accident, and Disaster
- Support of restoration in construction work.
- Support of measures against leakage.
- Support of recovery after earthquake disasters.

(3) Planning
- Diagnosis of obsolescence of pipeline facilities.
- Refurbishment plans for pipeline.
- Maintenance plans for pipeline facilities.
- Planning of measures against disaster (earthquake and water shortage).
- Plans for transport distribution and use of water.

2.3 Benefits of System

The following benefits can be expected from the introduction of this system:

(1) Integration of Maps and Pipeline Information
The integration of drawings and pipeline facilities makes possible an awareness of accurate information and rational maintenance and management based on the information.

(2) Maintenance and Management Based on the Up-to-Date Information
Appropriateness and reliability of activities are improved by use of latest information.

(3) Maintenance and Management Based on Accumulated Historical Records
It is possible to predict the future of pipeline facilities based on simulations for the analysis of risk using data recorded since the completion of the facilities and the latest data available at present.

(4) Easy Planning of Installation of New Pipeline and Refurbishment of Existing facilities

(5) Rapid Measures in Case of Accidents or Disaster

2.4 System Configuration

As shown in **Fig. 1**, the system is composed of a basic system for the image processing of a graphic information data base and an attribute information data base

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** Dr. Engi., Senior Researcher, Structure Lab., R & D Center, Engineering & Construction Div.
*** Structure Lab., R & D Center, Engineering & Construction Div.
**** Staff Deputy Manager, Water Works & Environmental Engineering Sec., Pipeline Engineering Dept., Engineering & Construction Div.

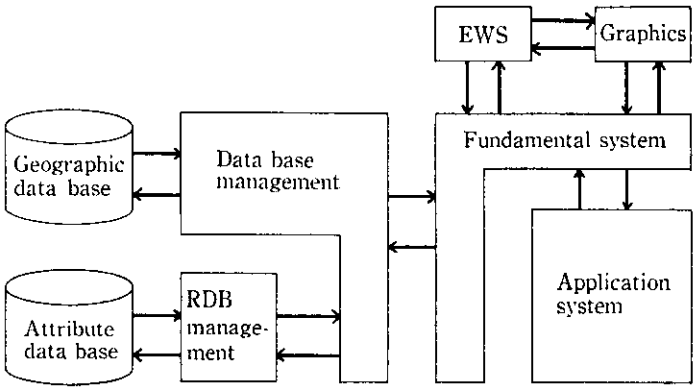

Fig. 1 System configuration

Table 1 Hardware configuration

Equipment	Function	Specification
EWS*1	Main memory	Over 8 M byte
	Disk	Over 350 M byte
	CRT	15 inch, color
I/O unit	Graphic display	20 inch, color
	Character printer	Printer speed 60 characters/s
	Electrostatic plotter	A1 or A0 size
	Color hard copy	A4 or A3 size
	Digitizer	A1 size

*1 Engineering Work Station

and an application system having various analytical functions. The specifications of the devices which comprise the system is given in **Table 1**.

3 Retrieval Functions

In addition to the basic function of retrieving drawings such as maps, pipeline diagrams, and valve and tap diagrams, the system provides various retrieval functions—retrieval of conditions, measures against accidents, materials, documents, etc.—to facilitate information retrieval appropriate to various activities. These functions make it possible to obtain detailed information on attributes using the following retrieval keys:

- Drawing Retrieval
  - Retrieval of index drawings
  - Retrieval of basic drawings
  - Retrieval of ancillary drawings
- On-Display Retrieval
  - Retrieval of pipeline
  - Retrieval of valves
  - Retrieval of water supply installations
  - Retrieval of users (houses)
  - Retrieval of instruments (measuring instruments, etc.)
- Condition Retrieval
  - Retrieval of pipelines
  - Retrieval of valves
  - Retrieval of water supply installations
  - Retrieval of users (houses)
  - Retrieval of instruments (measuring instruments, etc.)
- Measures against Accident
  - Indication of shutoff valves
  - Indication of areas of water stoppage
- Material Retrieval
  - Materials in the warehouse
  - Materials in the charge of designated contractors
- Document Retrieval
  - Complaints and accidents
  - Patrol and inspection
  - Investigation and analysis
  - Repair work
  - Maintenance work
  - Approval and authorization
  - Others

A typical image display of condition retrieval is shown in **Photo 1**.

4 Analytical Functions

The analysis functions are composed of groups of analytical programs necessary for analyzing the present condition of pipeline facilities to be managed and predicting their future condition. The following five groups of program packages are available for waterworks facilities.

〈Application Programs for Waterworks Facilities〉

(1) Hydraulics Analysis
- Analysis of steady-flow pipe networks.
- Analysis of water hammer.

(2) Water-Quality Analysis

Photo 1 Graphic display of water distribution system in the retrieving mode

- Analysis of residual chlorine concentration.
- Analysis of retention time in pipe networks.
- Analysis of risk of red water.

(3) Prediction and Diagnosis of Risk
- Prediction of risk of water leakage.
- Diagnosis of obsolescence of pipelines.

(4) Support of Measures against Accident and Disaster
- Expert system for supporting measures against accidents.
- Expert system for supporting recovery after disaster.
- Expert system for water stoppage work.

(5) Support of Planning Activities
- Support of plans for transport, distribution, and use of water.
- Support of plans for refurbishing existing pipelines.

5 Concluding Remarks

This lifeline information management system is expected to serve as a useful tool in improving the quality of maintenance and management affairs of pipeline facilities.

The system will be made easier to use by improving the functions of the basic and application systems and the application of the system will be expanded to a wider range of fields in the future.

For Further Information, Please Contact:
Pipeline Engineering Dept., Engineering Division
Fax 03(597)4948 Phone 03(597)4457