8.5 Computer Aided Tariff Collection System

In this section the Study Team proposes improvement plan of tariff collection by using computer aided system.

Firstly, we propose the appropriate tariff collection procedure, in which computer systems are efficiently used. Secondly we propose the improvement plan about software and hardware of the computerized tariff collection systems, which conform to the appropriate procedure. Finally we describe how the improvement plan should be implemented, including estimation and analysis of cost and benefit of implementation of the proposed computer system.

8.5.1 Proposed Computer Systems

In this section the detail specifications of proposed computer systems for tariff collection in Chirchik City Vodokanal are described.

(1) Overview

Although the current Tariff Collection System at Chirchik City Vodokanal covers core functions of tariff management, it requires further development to overcome the shortcomings in various points, as stated in Chapter 4. It is crucial to make and carry out a comprehensive long-term plan which aims to reform the current Tariff Collection System in concurrence with implementation of meter installation plans.

It is important to design and develop an effective computerized tariff collection system which can process more data transactions with less human resources. It is then necessary not only to install a computer system which conforms to the specifications of software and hardware described in this section, but also to reform staffing and business procedures to operate the computer systems efficiently as stated in the previous section.

We observe that Chirchik City Vodokanal can be used as a pilot site for the computerized Tariff Collection System throughout the country, unlike the capital city which is too large to be a pilot

site. We therefore propose that the new tariff collection system be extended to the Vodokanals in other cities in phases.

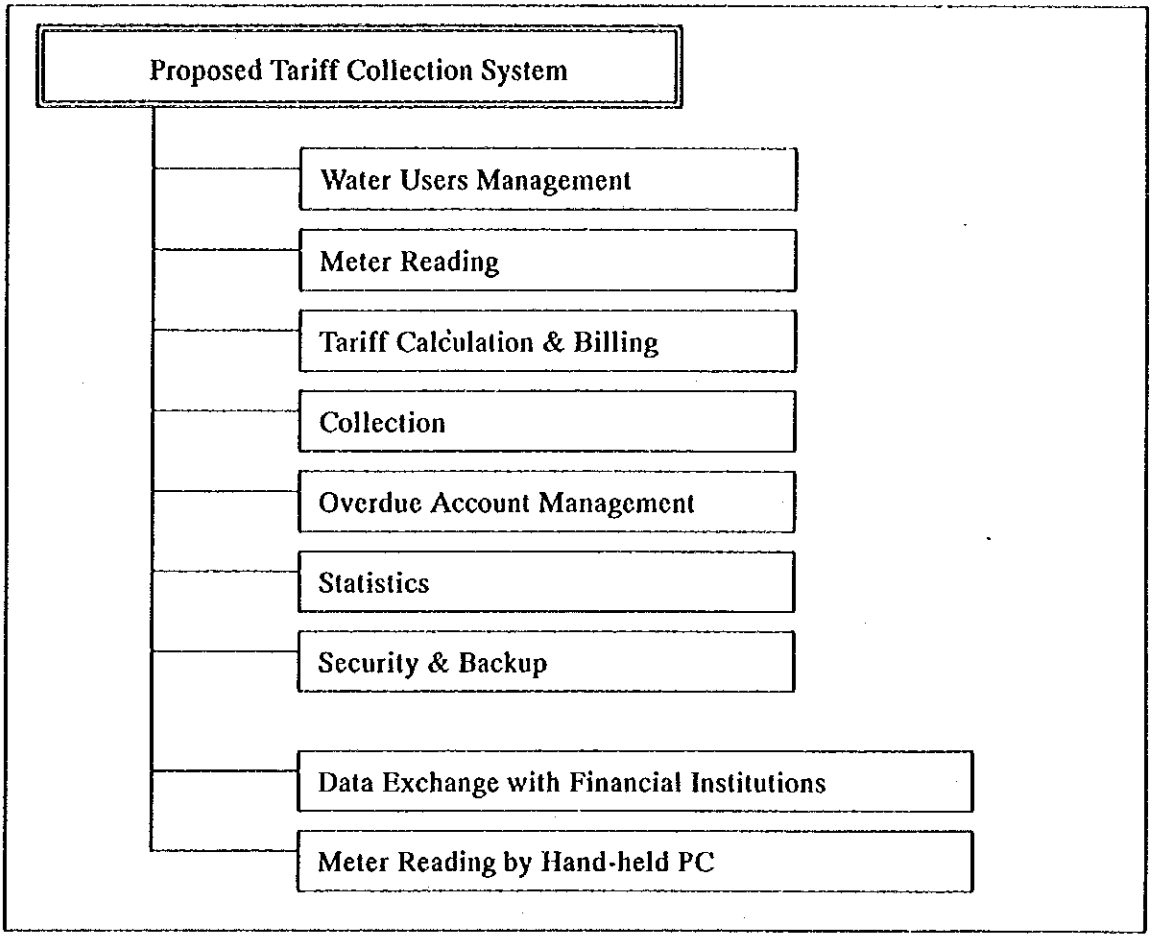
(2) Functions of Proposed Tariff Collection System ; Database

1) Study and Recommendation Approach

The common method to determine the specification of computer systems is to analyze the functions of application software to be used mainly and thereafter to decide the specification of computer hardware which is appropriate to the application software. At first we also start from the analysis of application software, i.e., the functions of Tariff Collection System.

In addition to the functions of current Tariff Collection System, we recommend that the proposed system provide some extra features which include various queries, production of statistical reports, and bulk data input by batch processing. These features are expected to facilitate more accurate and effective data processing without increasing the number of computer operators.

Fig.8.5.1 Proposed Tariff Collection System Function Diagram



As stated above, we propose that the computer systems to be implemented at Chirchik City Vodokanal be enhanced to the other Vodokanals in future. It is thus important to carry out a snap survey of other Vodokanals so as to estimate the data volume for analysis of systems performance and capability.

The countermeasures and proposed solutions elaborated in this section are based on the assumptions specified in Fig 8.5.1, i.e., number of installed meter, number of staff in charge of meter reading, and frequencies of meter reading. In the event that the proposed Tariff Collection System is implemented at other Vodokanals, similar qualitative and quantitative analysis should be undertaken to determine the specifications, especially quantity of computer equipment. Some data may be subject to change according to the tariff collection policies to be im-

plemented.

Most of the functions of the proposed system are based on on-line processing, but there should be some batch processing partially to input bulk data in order to achieve the effective utilization of computer resources and the efficient business procedures. The batch processing applicable to the Tariff Collection System includes data input from floppy disk or other medium, periodical printout, etc.

The proposed functions of the Tariff Collection System include, but not limited to, the following items: -

- Water Users Management;
- Meter Reading;
- Tariff Calculation and Billing;
- Collection;
- Overdue Account Control;
- Statistics;
- Security and Backup;
- Data Exchange with Financial Institutions; and
- Meter Reading by Hand-held PC.

2) Water Users Management

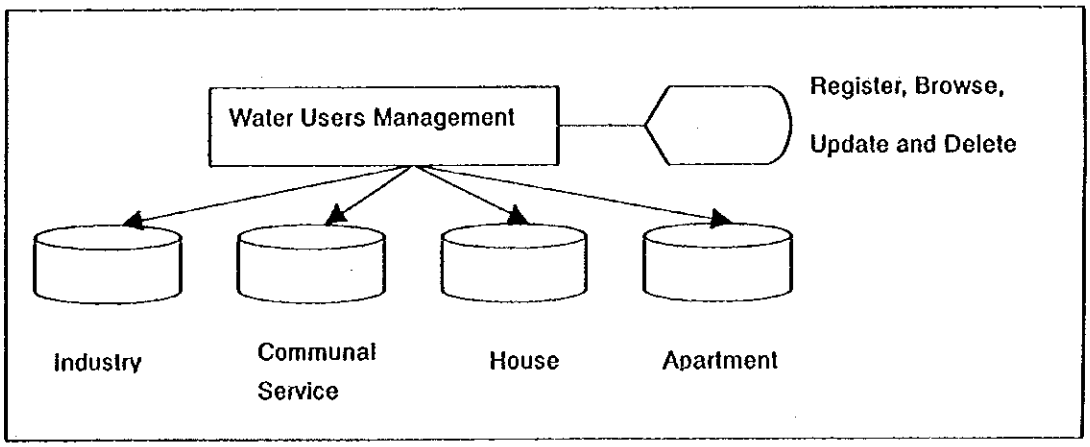
There are two possible elements as the key item of the database of the Tariff Collection System, namely, Water Users and Meter. Some software packages used for water tariff collection are designed to set up the Meter as the key item, but they are applicable only if almost all houses and apartment buildings have a meter. In consideration of the present situation of Chirchik City Vodokanal, it is more appropriate to set up the Water Users as the main key item of database.

The current Tariff Collection System has separate databases for industry users, communal services users, house users and apartment users. In future these groups should be unified to simplify the tariff collection business, but at this stage, it will be reasonable to design separate databases grouping by type of users as specified in Fig 8.5.2.

For the purpose of administration, a user code should be allocated automatically when the application for water use from a new user is processed by the computer system. The automatic allocation of customer code will provide the Tariff Collection System with a useful database system.

The current tariff collection system does not set up a user code for each water user, and it may result a waste of data storage and slow-down of systems performance if there is more data.

Fig 8.5.2 Concept of Water Users Management Module



The user attributes to be saved in the database will include user name, address, number of family, ward name, number of meters installed, staff in charge of meter reading, date contract made, method of payment, reduction and exemption of water tariff, etc.

It is important to optimize the database structure when a large amount of data is included in the database. We propose the following process which are generally used: -

- to draw up images of input screens and output lists through interviews with systems users;
- to extract the items to be included in the databases from the images;
- to analyze the relationship between items and come up with the database structure.

This process is called normalization of database and it is essential when a database is designed.

We observe that the current system needs to improve in terms of query functions. When a particular water user is searched various attributes should be used as key items so that the database can be utilized most strategically. Therefore we propose that the database be designed through the process stated above.

3) Meter Reading

The volume of meter reading data will be enormously increased as more meters are installed. We propose that the system be reformed in order to accelerate the processing speed. There are two concrete solutions proposed; one is to re-design the input screens to reduce the number of key touches, and the other is to utilize some input devices and feed bulk data through a batch processing. The latter includes data input from hand-held terminals for meter reading, and we mention it later.

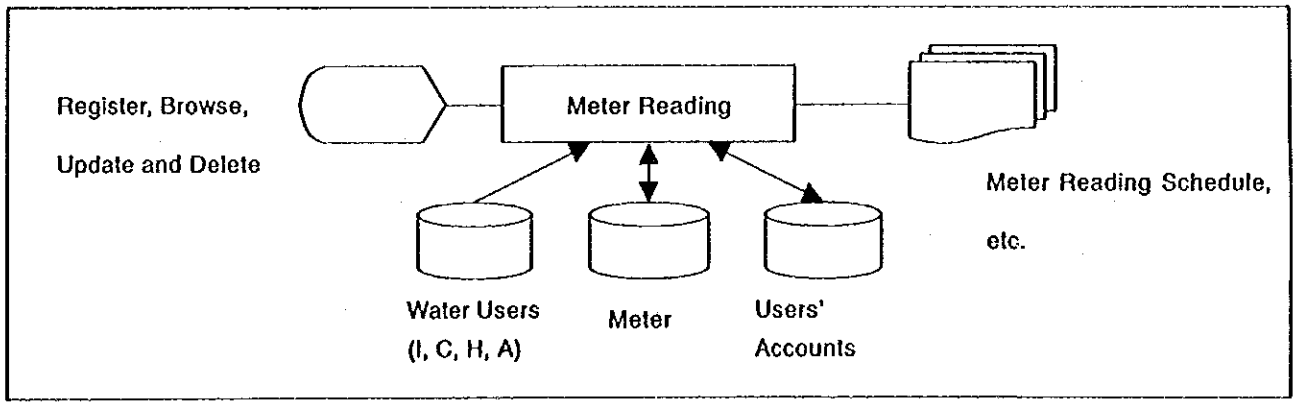
The systems functions of meter reading will include management of meter, management of staff in charge of meter reading, management of meter reading schedule, and inputting volume of water consumption.

The main function of Management of Meter will be to register, update and inquire and delete various attributes regarding meters, e.g., meter serial number, type of meter, date the meter installed, date the meter to be updated, etc.

Management of Staff in charge of Meter Reading and Management of Meter Reading Schedule are meant to support the staff in charge of meter reading to visit more users in a shorter time, as there will be more users who have meters according to the installation plans of meters. We propose that the computer system produce a schedule of meter reading by staff in charge of meter reading on a daily or weekly basis.

As for Inputting of Volume of Water Consumption, it is estimated that inputting there is a need to input the result of meter reading about forty seconds per a user. We propose that the system be refurbished for operators to input the data at above speed, e.g., reform of input screens and short-cut keys.

Fig 8.5.3 Concept of Meter Reading Module



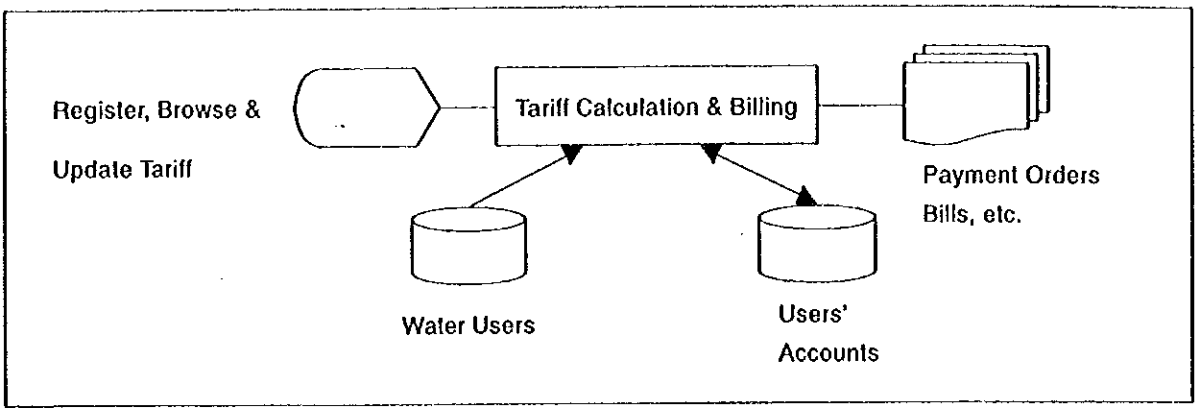
4) Tariff Calculation & Billing

The current Tariff Collection System conforms to the calculation of penalty which is adapted for users who exceed the limitation of water use but there is a need to modify some programs to adapt for the progressive water tariff table proposed by the Study Team.

As for billing of the current system, Akt is currently used for industry and communal service users while Customer Book is used for house and apartment users. The processing time of tariff calculation is expected to extend if the progressive tariff table is adapted. We suggest that the meter reading process be simplified as much as possible and that tariff calculation and

billing be conducted separately so as to save processing time.

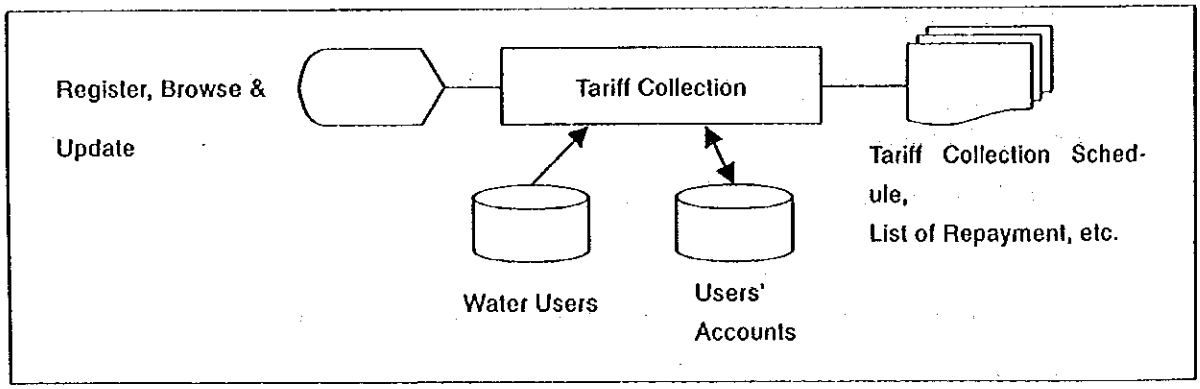
Fig 8.5.4 Concept of Tariff Calculation & Billing Module



5) Collection

We learnt that industry and communal services users pay tariff from their bank accounts while population users pay mainly at People's Bank or pose offices. The list of repayment received from banks are input into the system and it takes about one minute to input one transaction according to the interview survey, and there is a need to achieve more speedy data input. We propose that the input screens be reformed as stated above and that digital data be received from the bank.

Fig 8.5.5 Concept of Tariff Collection Module

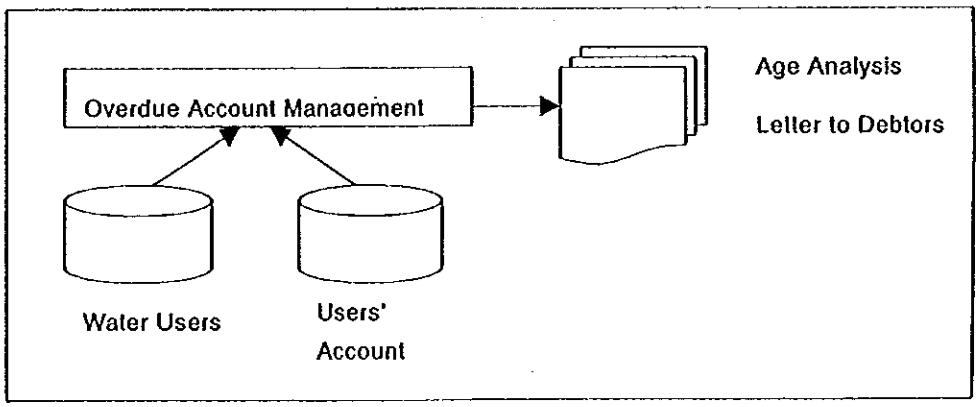


6) Overdue Account Management

In consideration of the plight of current socioeconomic situation in the country, it is estimated that there will be more amounts of overdue account in the future. It is therefore thought that overdue account management should be enhanced among the Tariff Collection System.

The overdue account collection is a difficult task. It is difficult to standardize the collection procedures and the collection is highly dependent on expertise of the staff in charge of tariff collection. The proposed system should provide the staff in charge of tariff collection with information regarding the overdue account instantly. We propose that the computer system automatically produce age analysis of overdue account, notification of overdue account, and the visiting schedule of staff in charge of overdue account collection, who would be able to be dedicated to visiting users. Then the collection rate is expected to improve.

Fig 8.5.6 Concept of Overdue Account Management Module



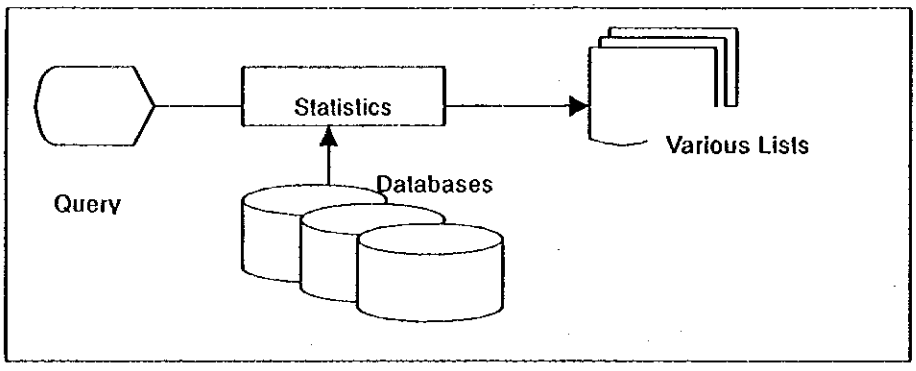
7) Statistics

The current Tariff Collection system can search for information on a particular user, i.e., volume of water consumption, payment and outstanding balances, etc. It is however necessary to enhance the system by adding the functions which will enable Chirchik City Vodokanal to obtain summarized statistics. The key personnel of Chirchik City Vodokanal require such statistics for analysis to determine various plans regarding overall management and planning of facilities constructions. We propose that the following outputs be produced regularly.

- Statistics on Customers (number of customers by user type, ward, method of payment and staff in charge, etc.);
- Statistics on Meters (number of meters by ward, age and model, etc. number of broken meter, number of repairs);
- Statistics on Tariff Calculation and Billing (number and total amount of tariff calculation and billing by user type, ward, method of payment, financial institution, staff in charge, etc.);
- Statistics on Collection (number and total amount of collection by user type, ward, method of payment, financial institution and month etc.);
- Statistics on Overdue account Collection (number and total amount of overdue account collection by user type, ward, method of payment, financial institution and month etc.)

We propose, as mentioned above, that a robust database be implemented by customizing a relational database software package in order to produce such statistical documents as easy as possible. It is possible to develop particular computer programs to produce such statistical documents, or alternatively, some database software such as Oracle can work in conjunction with popular spreadsheet software such as Excel and produce ad-hoc statistical documents on request.

Fig 8.5.7 Concept of Statistics Module



8) Security & Backup

It is critical to build the functions of security and backups in the computer system. The current Tariff Collection System does not embed adequate security and backup features. We propose that the following elements be included in the tariff collection system.

i) User-id and Password

We propose that each user of the computer system be given a user-id and password to access the tariff collection system to prevent unauthorized users from entering into the computer system. The user-id and password should be allocated by a systems administrator initially. It is necessary to set up some levels of users according to their grades and responsibilities.

ii) Physical Security

Since the computer equipment is quite valuable, we propose that the computer equipment be situated in lockable offices. The hand-held terminals for meter reading should be returned to the computer room when the staff in charge of meter reading finishes daily work, and quantity of the terminals should be counted every day.

iii) Anti-Virus Software

We propose that anti-virus software be installed in all computer equipment to prevent malicious programs from invading the computer system. Since new virus programs are produced every day somewhere in the world, we also propose that the program be updated or upgraded regularly.

iv) Backup and Recovery

The databases must be protected against unpredictable accidents caused by systems malfunctions. We propose that all databases be kept in the backup tape at the end of every working day. For the large installation sites, it may be appropriate to implement a data mirroring system for seamless operations. The data mirroring system has two databases whose contents are updated simultaneously, and even if one database corrupts, the

computer system can work by using the other database.

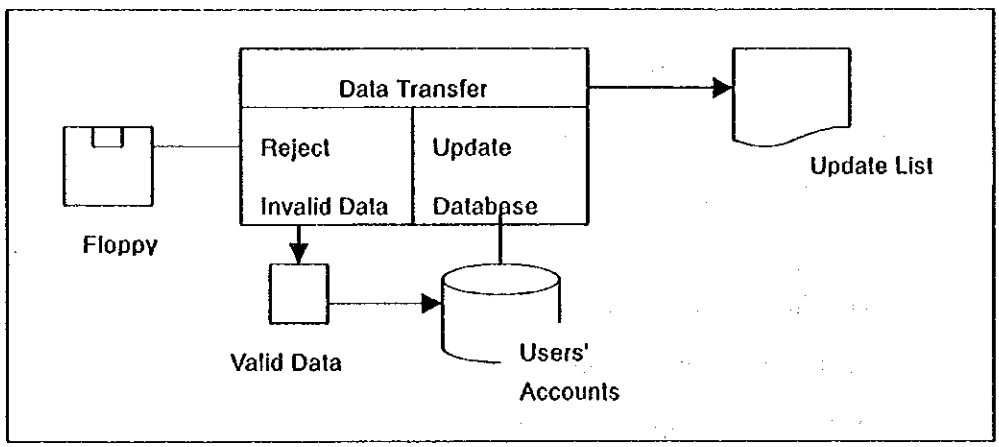
9) Data Exchange with Financial Institutions

The next two sections describe the additional functions which will significantly reduce the data processing time. This section describes the data exchange with financial institutions while the next section describes hand-held terminals for meter reading.

Chirchik City Vodokanal currently receives a list of payment from water users from the bank on a daily basis, and an operator inputs the information from the list. We propose that, in consultation with the bank, digital data be received from the bank. The data input through floppy disk will reduce not only the processing time but also operation errors.

It is needless to say that this will be done only when the bank agrees to provide the information on payment by digital data. The Tariff Collection System will need to add some functions, i.e., data validity check, production of list from floppy disk, and updating database. It will be technically possible to receive data through modems, but it is not an appropriate solution as public lines are still under-developed in this country.

Fig 8.5.8 Concept of Data Transfer from Financial Institutions Module



10) Meter Reading by Hand-held Terminals

Hand-held terminals are widely used for meter reading of water use as well as electricity and gas. The main advantage of hand-held terminals is that it is not necessary to input data twice so that the efficiency of procedures will be improved. In case of manual recording at meter reading, it is necessary to transcribe the information after going back to the office. On the other hand, the hand-held terminals can memorize the information electronically and transmit the information to the database directly. The hand-held terminals can also improve the accuracy of data.

The typical specifications of hand-held terminals are found in Chapter 7. The hand-held terminals were invented recently, but they are becoming popular. They can be connected with not only mainframe computers but also affordable personal computers. On condition that the hand-held terminals are customized for Russian languages and a local agency provides the maintenance services, we propose that hand-held terminals be implemented to accelerate the meter reading.

The water consumption data is usually captured through an input device such as keyboard or touch panel, but the latest hand-held terminals which are equipped with remote data transfer facilities can read meters without looking at the figure of the meters and typing digits. These gadgets can prevent human errors on typing and shorten the time of meter reading because it will be needless to look at the meters. However, in order to utilize the remote data transfer facilities, there will be a need to install expensive meters which have interfaces with computers, and therefore this will be a realistic solution when the price of these meters becomes affordable in the future.

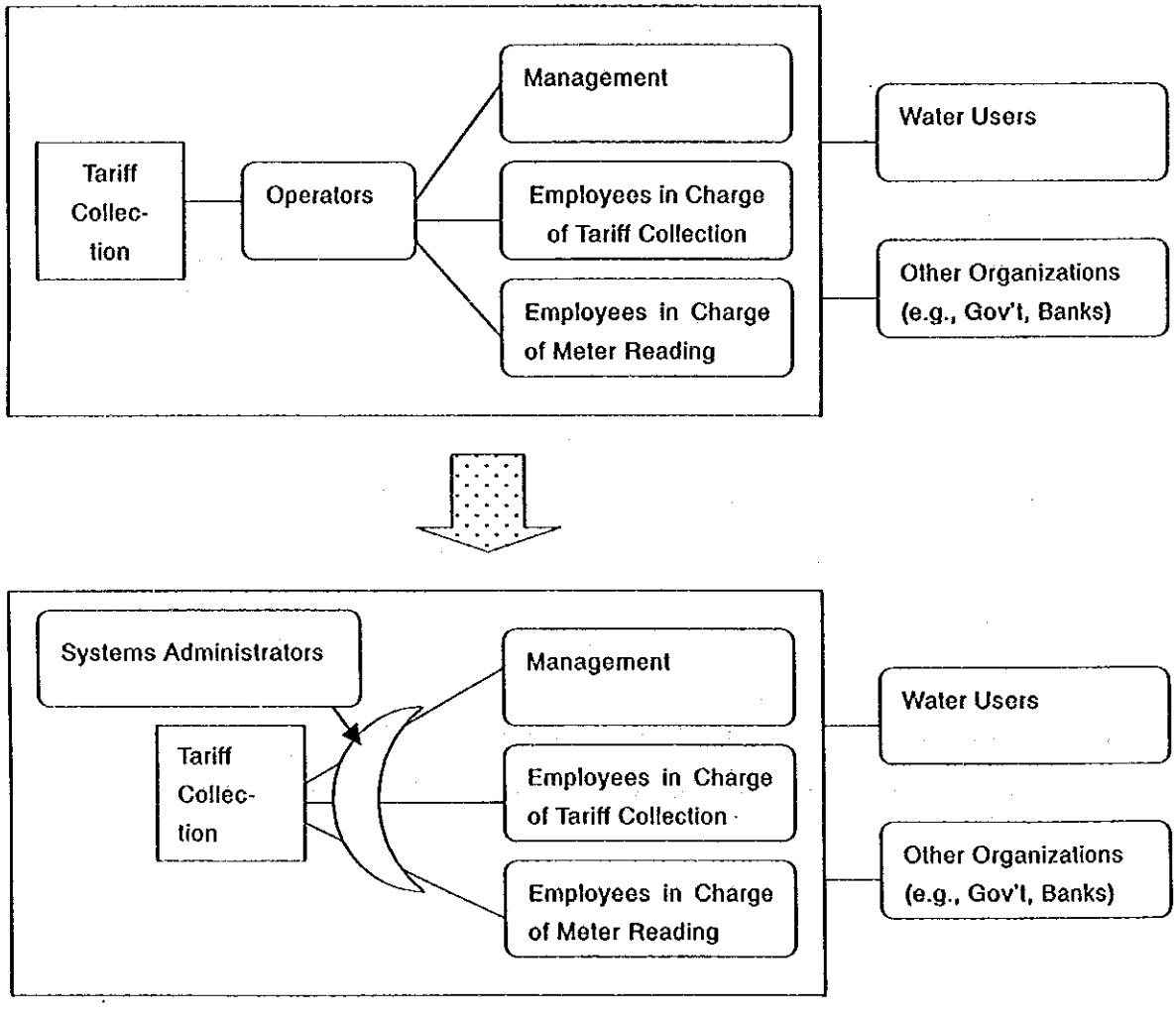
(3) Functions of Proposed Tariff Collection System; Networking

In this section we describe our proposals on specifications of networking of Tariff Collection System.

The current Tariff Collection System consists of some stand-alone computers within the office of Chirchik City Vodokanal only. The number of computer terminals is insufficient and they cannot transfer the data with each other. We believe that the computer systems should be accessed by managers and key personnel, staff in charge of meter reading and tariff collection before the number of transactions grow up to the alarming level. Therefore we propose that the new tariff collection system be a Local Area Network (LAN) system.

We also propose that a systems administrator be assigned to control the future LAN. The duties of the systems administrator will include, but not limited to, overall computer security management, daily backup of database, recovery of the systems in case of malfunctions, introductory training for systems users, liaison with computer programmers and hardware suppliers in case of hardware breakdowns.

Fig 8.5.9 Context Diagram of Proposed Tariff Collection System: Networking



(4) Proposed Tariff Collection System; Database and Programming Tools

In the next two sections we propose computer hardware resources necessary to operate the application software discussed in the previous section. First in this section we analyze the middle-ware such as database and programming tools. We then propose the appropriate computer hardware including database server, terminals and peripheral equipment, and finally we propose the networking components which integrate all the computer resources.

1) Comparison between Custom Software and Package Software

There are two kinds of application software: one is custom software, which is designed and developed for a particular user in conformity with the user requirements. The other is package software, which is designed and developed for unspecified number of users and available on the market. There are a lot of software packages designed for water tariff collection. (Note: We have not confirmed that Russian version of such package software is available or unavailable.)

The main advantage of package software is that the program is tested and used by other users of water works sector and especially the software upgraded many times is usually versatile and user-friendly. Another advantage is that the period to implement the system is generally shorter than that of custom software, in most cases all the systems users have to do is to input some parameters into the system. On the other hand, however, package software may not address several user requirements if they are specific and unlike those of other users. In addition, if there is any change of legislation or protocols, it may be necessary to modify the source code of programs. The copyright and patent of computer software is usually reserved by the company or person who developed the software, and the systems users may not modify the programs without permission of the developer. Hence, it is common that if a user purchase package software he has a maintenance contract with the developer or its agent.

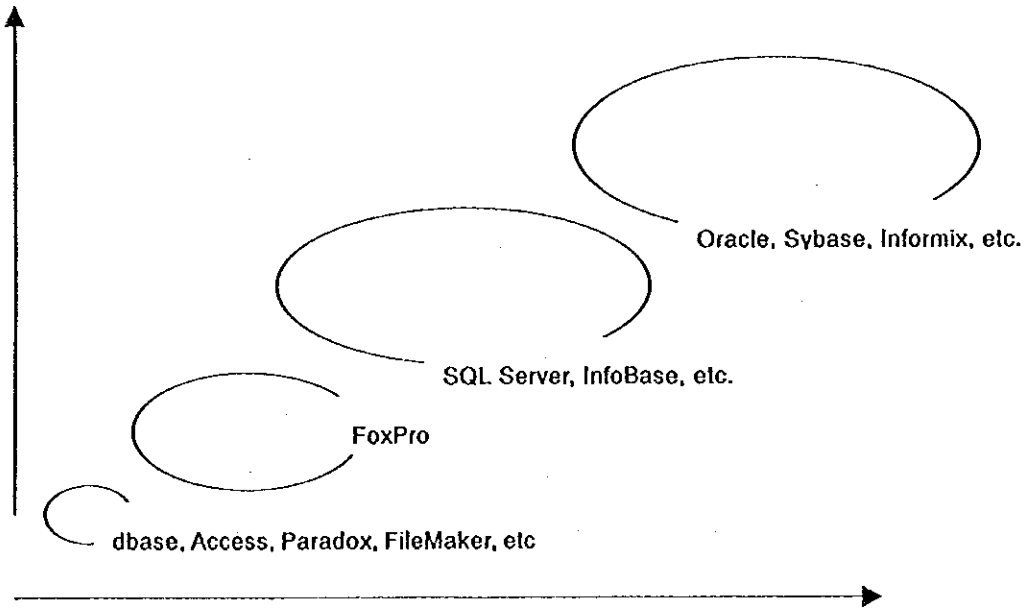
It is observed that it will be easier to find companies which develop custom software in this country. It is questionable to maintain the package software whose market is still immature. We therefore propose that the custom software be designed and developed by a reputable local company or a foreign company which has a local agent in this country.

2) Database and Programming Tool for Custom Software

In this section we then propose the database and programming tools suitable to develop the Tariff Collection System for Chirchik City Vodokanal.

There are various kinds of database software. They are classified by data volume and number of users who concurrently access to the database. The following diagram indicates the appropriate data volume and number of systems users of the major database products.

Fig 8.5.10 Appropriate Number of Systems Users and Data Volume of Major Database Products



The current tariff collection system was developed by using Pascal programming language. It does not robust database engine, which we think will result in low systems performance if data volume increases.

We therefore propose that a proper database with adequate capacity, such as FoxPro or SQL Server, be utilized as the database system of the proposed Tariff Collection System.

As for the programming tools, we propose the products which are compatible with the database to be installed. The popular programming tools, such as Delphi which is based on Pascal language, provides the systems developers with the graphical users environment (GUI) and various built-in parts which can shorten the development period significantly.

3) Operating System

Finally, we describe the operation systems to be used for the proposed Tariff Collection System. There is a need to install a network operating system if the computer terminals are connected with each other. We propose a popular operating system, such as Microsoft Windows NT or Novell NetWare be utilized as a network operating system, while Windows 95 or its successors should be installed on each computer terminal.

(5) Proposed Tariff Collection System; Computer Hardware

In this section we propose the computer hardware to be used for the Tariff Collection System.

1) Overview

The hardware components should be determined by the data volume and number of users.

We firstly discuss the type of database server which will hold all data. There are two options for database server, namely, mainframe and personal computer (PC) server. The former overwhelms the latter in terms of capacity and performance, but it is expensive and requires special skills to operate.

In consideration with the magnitude of data volume, there is no need to install a mainframe based database server, and we conclude that a PC server is appropriate for the Tariff Collection System.

Other computer hardware required for the proposed Tariff Collection System includes computer terminal, input devices such as floppy disk drives, and other peripheral equipment. We discuss their specifications in the following sections.

2) Specifications of Database Server

In the following paragraphs we discuss the detail specifications of a PC server, which we propose as a database server for the tariff collection system described in the previous section.

The networking system usually requires more computer hardware resources. It is therefore necessary to empower the current equipment by adding a database server with adequate performance. The specification of the proposed database server is described as follows, although it should be reviewed and modified when the new system is implemented, as the information technology improves day by day.

Proposed Specifications: -

Processor(s)---should be compatible with Windows NT and the clock speed should be at least 400 MHz (e.g., Pentium or its compatible processor).

Main Memory (RAM)---At least 256 Megabyte (MB)

Storage Devices---At least 8Gigabyte (GB) hard disk drive with optional disk mirroring function complying with RAID 5.

Interfaces---to recognize other storage devices such as floppy disk and CD-ROM drives.

3) Specifications of Computer Terminals

In the following paragraphs we discuss the specifications of computer terminals which are to be used by systems users.

There are two kinds of computer terminals on the market, namely intelligent terminals and dumb terminals. The latter is no longer popular as it does not function unless it is connected with the server. On the other hand, intelligent terminals can be utilized as a standalone computer as well and have become affordable. The specifications of computer terminals should

run on the operation system of Windows 95 or its successors. If the application system adopts the Graphical User Interfaces (GUI), more main memory will be required while the minimum specifications of such computer terminals are described as follows: -

Specification

Processor---Pentium or its compatible processor with at least 100 MHz speed;

Main Memory (RAM)---at least 32 MB;

Interfaces with networking

It is proposed that outdated computers be gradually discarded and replaced by new machines.

4) Specifications of Peripheral Equipment Excluding Networking Components

In the following paragraphs we discuss the specifications of peripheral equipment to be used for the proposed Tariff Collection System of Chirchik City Vodokanal. The peripheral equipment includes printers and hand-held terminals.

Printers are output devices which can generate various documents from computers. There are several kinds of printers on the market, namely, high-speed impact printer, dot matrix printer, laser printer, inkjet printer, receipting printer, etc. Appropriate printers should be selected according to the functions of software and user requirements.

The high-speed impact printers are suitable to generate bulk documents such as bills, repayment schedule, etc. We propose that at least one high-speed impact printer be installed.

As for input devices, hand-held terminals will be required, depending on how the input data is captured. A storage device such as 4mm-tape streamer will be required for backup and recovery purposes. The currently used device may be used or upgraded if data volume becomes large.

It is also essential to install an uninterruptible power supply unit (UPS) in order to protect the database server and other important gadgets from power interruption.

(6) Training

In this section we discuss the aspects of computer training required to design, develop, operate and maintain the Tariff Collection System.

1) Overview

We learnt that the current computer system was developed by an external programmer, and that there is no computer specialist at Chirchik City Vodokanal. A huge investment on human resources would be required if Chirchik City Vodokanal would attempt to design and develop the proposed system. We therefore propose that the computer system be designed and developed by a computer company which has sufficient knowledge and experience of development of similar systems.

We propose two types of computer training as specified below, that is, one is the training for systems administrators, and the other is the training for systems users.

2) Training Programs for Systems Administrators

There is a need to provide computer training for systems administrators whose duties will include provision of first line maintenance and basic training for systems users, undertake daily backup of databases, allocate user-id and password for systems users according to the user level. The systems administrators require fundamental skills of operating systems and database package, and such training courses are available in this country.

3) Training Programs for Systems Users

Finally, the systems users need to be computer-literate in order to operate the system. In this country, the basic computer training is provided even at primary education, and there is no need to provide introductory training such as keyboard awareness. All the systems users need is how to use the Tariff Collection System, and it should be provided by programmers and systems administrators.

8.5.2 Master Plans and Feasibility Analysis

In this section the Study Team proposes the master plans of refurbishment of computer systems at Chirchik City Vodokanal.

In the first section we propose the following plans. In short term Vodokanal will need to modify the current Tariff Collection System according to a new tariff table and expand the hardware. But in a long term the Tariff Collection System at Chirchik City Vodokanal should be developed and the system should be expanded in other Vodokanals.

We think that other Vodokanals in Uzbekistan encounter similar problems of Tariff Collection System. We therefore propose that Chirchik City Vodokanal be a pilot organization of proposed Tariff Collection System, which will be completed by 2004. The Study Team proposed the first stage target year 2005 in the previous section, the Tariff Collection System therefore should be completed by 2004 and be used from 2005. In the next second phase, this system should be implemented subsequently in all other cities.

Secondly we estimate the approximate costs for the implementation of the sales management system in the first phase.

Then we explain the main effects expected by introducing the proposed computer system. We also estimate the number of employees required for tariff collection.

(1) Master Plans of Implementation of Proposed Computer Systems

The Master Plan of Improvement of Tariff Collection by Using Computer Aided System for Chirchik City Vodokanal is shown in this section. We have two types of proposals: one is for the short-term, and the other is for the long-term strategy.

The long-term strategy has two phases. The first phase extends to Year 2004, when the implementation of meters installation at all houses and apartment buildings is expected to complete. Since a computer system should be modified according to the users' requirements and business

procedures from time to time, the Tariff Collection System should be developed and modified gradually in accordance with the implementation of other proposals of the Study Team.

The systems regarding sales management should be completed by 2004. The main functions of the sales management system is tariff collection - customer registration, billing, tariff collection, and outstanding control. At the same time, it will be necessary that other Vodokanals are also surveyed and the tariff collection procedure should be standardized. Namely, the pilot Tariff Collection System should be completed by 2004.

In the second phase, the pilot Tariff Collection System will be expanded to all Vodokanals countrywide by 2010.

1) Short-term Plans

In this section we describe a short-term plan to overcome the immediate problems.

i) Modification of Tariff Table

The first priority may be given to the modification of tariff table. The current Tariff Collection System does not conform to the progressive tariff table proposed by the Study Team, and it is necessary to amend some computer programs by the time the new tariff table is implemented. We observe that the programmer contracted by Chirchik City Vodokanal is able to understand the logic of new formula and modify the programs by himself. We estimate that this process will take place within a few weeks.

ii) Replacement and Enhancement of Computer Equipment

We understand that Chirchik City Vodokanal faces the severe lack of computer equipment for their systems and that there is a need to add some terminals in order to process the input data. Through this project, some computer equipment is transferred to the counterpart of the Study Team. Each computer has a network interface card so that it can be easily utilized as a computer terminal of the current and proposed Tariff Collection Systems. We propose that more computer equipment be installed gradually, as specified in the Master Plan.

2) Long-term Plan; the First Phase

In this section we describe the long-term plan of Tariff Collection System.

i) Replacement of the Current Tariff Collection System

We propose that the current Tariff Collection System should be replaced by a newer technology in order to improve the systems performance and capability. This component should also include the implementation of new databases with higher capacity, hand-held terminals for meter reading and data exchange with financial institutions through diskettes.

We propose that a waterfall model be used as the methodology of systems design and development as described in Chapter 7. We propose the development of proposed Tariff Collection System be divided into six stages, namely, Requirements Analysis, Fund Raising, Detailed Design, Procurement of Hardware and Networking, Development and Testing, and Transition Arrangements and Training.

a. Requirements Analysis

We propose that the Requirements Analysis be conducted after the completion of JICA Study and approval of our countermeasures and solutions. During this stage, the following tasks should be undertaken: -

- review of countermeasures proposed by JICA Team;
- collection of supplemental information of the current Tariff Collection System through interviews with systems developers and users, as well as study of the input screen, source code, output list and related documentation;
- collection of supplemental information of the future requirements pertaining to the future Tariff Collection System;
- detailed estimation of systems performance and data volume at least for the next five years;
- final specifications of software, hardware and networking and installation plans. These should include the database, operating systems, programming tools to be used, type and

quantity of hardware, networking topology and range;

- strategy of systems development;
- necessary arrangements on business procedures including the impacts on other computer systems;
- detailed training plans;
- possible sources of funds to the project;
- expected effects from the project;

We propose that external consultants who are familiar with business on Water Works and computerized tariff collection or billing systems be engaged to organize the Requirements Analysis. Since the computerization should be extended to the national level, we propose that the staff of Vodokanals throughout the country, in conjunction with some local programmers, also be involved at this stage. We also propose that during this stage, a prototype application system should be developed so that the system users would be able to imagine the future Tariff Collection System. The output of this stage should be compiled as a Specifications Analysis Report, which would be used to seek sources of funding. We estimate that this stage will take approximately eight to twelve months.

b. Fund Raising

We estimate the total initial cost as specified in the next section. Soon after the Requirements Analysis stage, there is a need for the authorities concerned to seek the source of funding for the project. The above-mentioned Specifications Analysis Report or an alternative document which clearly describes the project magnitude in terms of financial investments should be used to seek the sources of fund. We propose, under the current circumstances, that the donor community, whether bilateral or multilateral, be requested to sponsor the entire project, because the total estimate cost is quite huge. We estimate that this stage will take place approximately three to twelve months, depending on the priority of this project.

c. Detailed Design

The stage of Detailed Design should be conducted in parallel with above-stated Fund Raising. During this stage, the following tasks will be undertaken: -

- review of Specifications Analysis Report;
- development of systems and procedural flow chart;
- description of systems functions;
- design of databases and files;
- design of input screens, printouts and other human-computer interfaces.

We propose that the same technical staff who would conduct the previous stage, i.e., Requirements Analysis, be continuously engaged in the Detailed Design, so as to maintain the consistency of specifications of the computer systems. We estimate that this stage will take place approximately eight to ten months.

d. Procurement of Hardware and Networking

Some computer equipment should be procured prior to the development of application systems. We propose that the procurement and installation of computer hardware and networking be undertaken at one time, as it will not be a huge installation. We also propose that a local supplier be engaged to install the computer equipment and maintain the systems thereafter to ensure smooth operations. We estimate that this stage will take place approximately three to five months, including the selection process of supplier(s).

e. Development and Testing

After the detailed design and installation of computer equipment are completed, the development and testing of the application system (Tariff Collection System) may start. The following tasks should be undertaken during this stage: -

- programming;
- systems functions test;
- systems performance test.

This stage should be undertaken by the systems analysts and programmers of local companies, who should be assisted by expatriate consultants if necessary. It is needless to say that the systems analysts and programmers should have knowledge on software products to be used for programming, such as database software, operating systems and programming tools.

f. Transition Arrangements

After completion of thorough test of the proposed computer systems, the stage of transition arrangements will take place. This component will consist of two main elements, namely, one is data transfer from the current system and the other is parallel operation with the current system.

- Data Transfer from the Current System

The current system has a database which holds a lot of information to be transferred to the proposed system. There are two methods to transfer the data, namely, one is the manual data capture and the other is to use computer programs for data transfer.

The manual data capture is tiresome and we propose this option only if it is difficult or impossible to develop the data transfer programs. The main disadvantages of manual data capture are that it will take a lot of time to complete the data transfer and that there is a lot of room of capture errors. Therefore we propose that some data conversion programs be developed and utilized for smooth databases transfer. We foresee that this stage will take place approximately three to six months until the data verification is completed.

- Parallel Operation with the Current System

We propose that the current and proposed systems be operated concurrently for a several terms to verify that the proposed system produces the correct results. The popular method to verify the results is to compare the outputs between the current

and proposed systems. We estimate that the parallel operation will take place approximately one month, if no crucial problem of the proposed system occurs.

g Training

It is essential to provide adequate training to the personnel of Chirchik City Vodokanal in order for them to utilize the computer systems effectively and efficiently. We propose the training courses for systems administrators and systems users respectively as specified in the previous sections.

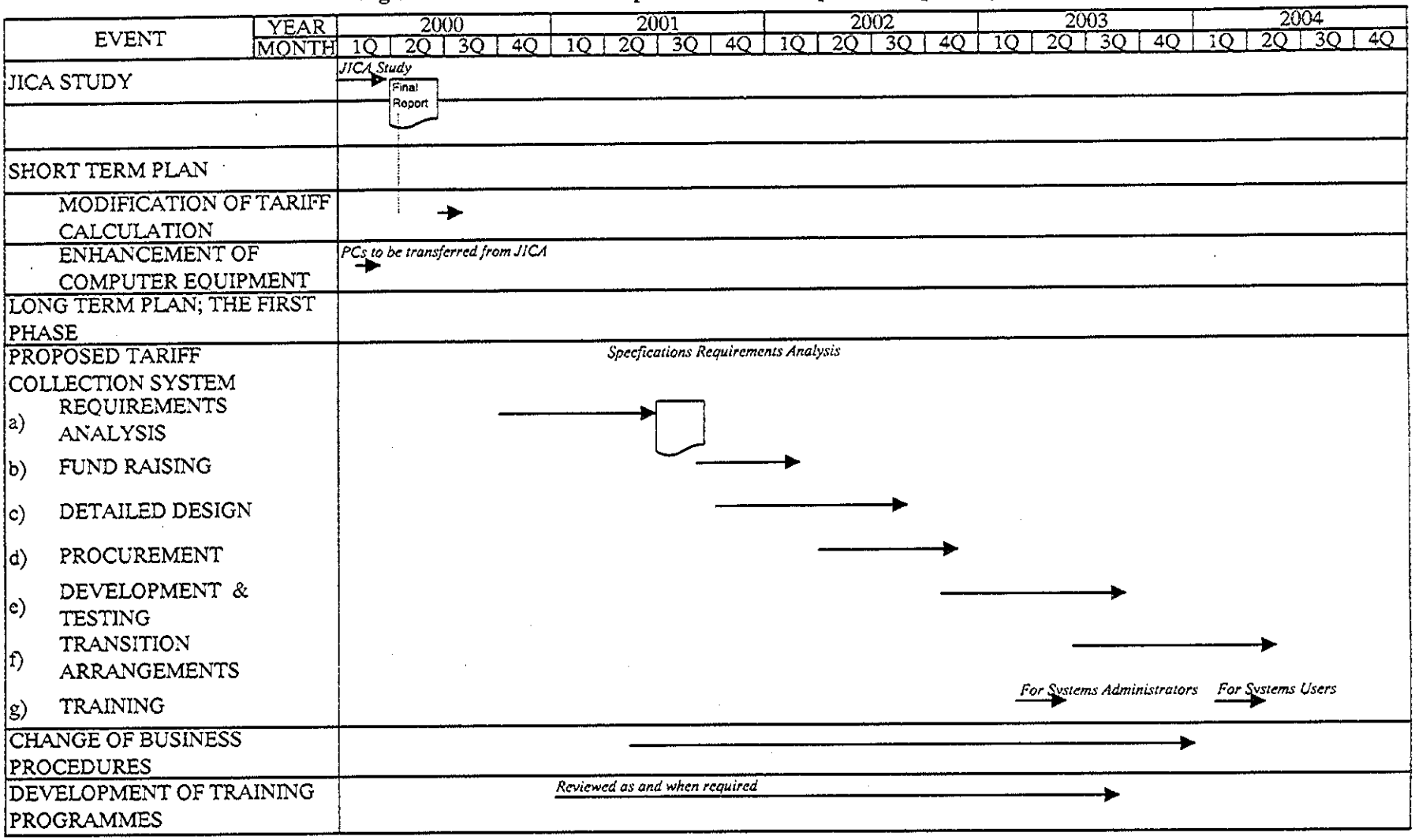
ii) Change of Business Procedures

We believe that any computerization project as large as this case should be implemented inconcurrent with the change of business procedures including restructuring of Chirchik City Vodokanal, review of personnel's roles, etc. We described some proposals in the previous sections, and it should be implemented in accordance with the implementation of proposed computer systems.

iii) Development of Training Programs

The information and computer technology is innovating day by day. It is therefore necessary for Chirchik City Vodokanal staff to catch up with the modern ideas of computers to prevent the systems from being obsolete. We specified some training programs towards year 2004, but we also propose that they be reviewed every year in accordance with the change of information technology and user requirements.

Fig 8.5.11 Master Plans of Implementation of Proposed Computer Systems



3) Alternative Long-term Plan;

Our proposals on long-term plans to rebuild the tariff collection system are described as above. We imply that Chirchik City Vodokanal will be a pilot organization among the Vodokanals across the country. However, if the project only aims at improvement of Chirchik City Vodokanal only for the moment, alternative plan may be considered as follows:-

We described in the previous section that a countrywide survey should be conducted at Required Analysis stage. If there is no need to consider the business of other Vodokanals, the survey will be focussed on the tariff collection at Chirchik City Vodokanal, and thus the total period of design and development of the system will be reduced. In this case we estimate that the project may be completed within two years.

We however believe that this project should involve not only Chirchik City Vodokanal but also other Vodokanals, because they all encounter similar problems. We also observe that the situation of other Vodokanals may be different from that of Chirchik City Vodokanal, as Uzbekistan is a big country geographically. We therefore propose that the long term approach involving all Vodokanals be apapted.

4) Long-term Plan; the Second Phase

The computerized tariff collection system should not be confined in Chirchik City Vodokanal, but it should be extended to other organizations. We believe that the expertise acquired through the implementation of proposed Tariff Collection System at Chirchik City Vodokanal will greatly contribute to the further implementation of tariff collection systems countrywide.

We propose that the second phase be divided into two stages: the first stage should start in 2005, soon after the first phase is completed and subsequently the second stage should start. We estimate that each stage take three years.

i) The First Stage : 2005 – 2007;

At the first stage of the second phase, the following components should be undertaken.

- to review the implementation of pilot tariff collection system at Chirchik City Vodokanal;
- to analyze the cost and benefit of the pilot project;
- to select several Vodokanals for the second implementation. We propose that at least 20% of all Vodokanals be involved in the second implementation;
- to carry out supplemental study at selected Vodokanals;
- to review the application software implemented at Chirchik City Vodokanal, and modify programs if necessary;
- to estimate the implementation cost and benefit of the second implementation;
- to raise the fund for the project, mainly for computer equipment;
- to change business procedures in necessary;
- to provide necessary computer training for the personnel;
- to procure and implement computer hardware and software;
- to move manual and digital data to the new database.

ii) The Second Stage : 2008 - 2010

Finally the remaining Vodokanals should be involved in the project and similar procedures will take place as the first stage.

(2) Estimated Costs

In this section we estimate the total cost of reform of the Tariff Collection System at Chirchik City Vodokanal according to the specifications described in the previous sections. It is however noted that this estimate is tentative and that it should be scrutinized after thorough analysis at Requirements Analysis.

We also note that the computer systems should be designed and developed not only for Chirchik City Vodokanal but other Vodokanals as well. The cost for the other Vodokanals should be estimated after the thorough analysis in the second phase.

For initial cost, we divide the cost elements by stages described in proposed Master Plan, namely, Requirements Analysis, Fund Raising, Detailed Design, Procurement, Development and Testing, Transitions Arrangements and Training.

The detail of estimation is described in Supporting Report. The following assumptions were made to calculate the cost.

1) Initial Cost

We estimate that the total initial cost is around USD 1,646,400, and the breakdown is listed as below.

i) Requirements Analysis

We assume that three expatriate consultant and five local consultants as systems analysts will be engaged for six to nine months. We estimate that this stage will cost approximately USD 708,000.

ii) Fund Raising

We assume that this stage will be carried out by internal human resources only. Hence no remarkable cost items are envisaged.

iii) Detailed Design

We assume that two expatriate consultant and five local consultant who have knowledge and experience on design of similar application systems will be engaged for six to ten months. We estimate that this stage will cost approximately USD 642,000.

vi) Procurement

We assume that meter reading takes place monthly for industry and communal services users and quarterly for house and apartment users respectively, and that one computer terminal will be distributed as per two staff who are supposed to access the computer system. The following table indicates the quantities of computer hardware per item. We estimate that this stage will cost approximately USD 128,400.

Table 8.5.1 Computer Hardware for the Proposed Tariff Collection System

Item	Quantity
Database Server with Backup Facilities	2
Computer Terminals (PC)	10
Computer Terminals (Hand-held PC for meter reading)	10
Fundamental Software (Operating System, Database, Programming Tool, Anti-virus etc.)	-
High-speed Line Printers	2
LAN Equipment (including Routers, Hubs, Cables, etc)	-
Security Equipment including UPS	-

v) Development and Testing

We assume that development and testing will be carried out by local systems analysts and programmers. One or two external advisory consultants will be engaged for about eight months. In addition to that, there is a need to develop emulation software for hand-held terminals to conform to Russian language, but it is not included in our estimation, as it is covered in Chapter 7. We estimate that this stage will cost approximately USD 150,000.

vi) Transition Arrangements and Training

We assume that two systems developers will be dispatched for overseas training whilst three systems administrators are to receive local training. We estimate that this stage will cost approximately USD 18,000.

2) Recurrent Cost for Operation and Maintenance

We estimate that the annual recurrent cost for operation and maintenance of the proposed Tariff Collection System is around USD 44,304.

i) Hardware Maintenance

We assume that the annual cost for hardware is 10% of its acquisition cost. Therefore we estimate that it will cost approximately USD 12,840.

ii) Software Maintenance

We assume that the annual cost for software maintenance is 10% of its acquisition cost (development and testing). Therefore we estimate that it will cost approximately USD 15,000.

iii) Consumable and Necessary Arrangements

We assume that the annual cost for consumable including paper, ink cartridge, backup tapes, etc., and other necessary arrangements such as improvement of physical security is 1% of total initial cost. Therefore we estimate that it will cost approximately USD 16,464.

(3) Expected Benefits

It will need a huge investment to develop computer systems. It is necessary to analyze the benefits of introduction of the computer systems, although it is difficult to estimate the exact benefit. There are two types of benefit: one is the qualitative benefit, another is the quantitative benefit. The quantitative benefit is usually more difficult to estimate.

It may not necessarily be more valuable to be able to estimate the quantitative benefit. And we do not only decide investment because of the quantitative analysis effect. The organization may sometimes decide to investment in order to other factor, e.g. grade-up of control, management.

In this section we explain the main benefits expected from the introduction of computer systems: improvement of services, improvement of management, and reduction of the personnel expenses.

There will be also a lot of other effects, for example, improvement of employees' morals, and improvement of quality of works by using computer system. In this section we detail such benefits.

1) Improvement of Services

Chirchik is not such a big city which has about 20 thousand populations, and the management of the organization is relatively easy in view of quantity. But since the public transport at Chirchik has not been developed compared with Tashkent, it is inconvenient of water users to go to Vodokanal. And it is also inconvenient to contact with Vodokanal, since telecommunication condition is worse than that in Tashkent.

If Vodokanal is requested to repair some equipment, it needs to attend the problem more quickly. By introducing the computer system, Vodokanal will be able to avoid careless mistakes, and respond more quickly and exactly, and work efficiently.

We think Chirchik is similar to other many cities, which have the same problems. It is very valuable that Chirchik is a pilot organization of tariff collection system, because this scheme should become the preliminary movement to the improvement of the water supply services for all Uzbekistan people.

2) Improvement of Management

It will be effective for Vodokanal management to introduce computer system. We explain the benefits at the point of three management levels. And if Chirchik City Vodokanal is the pilot case and the system is expanded to all over the Uzbekistan, the following effects refer to other many cities. Moreover we propose all Vodokanals should be connected with, which makes the water supply management in Uzbekistan be dynamic improvement.

i) Top Management

Top management will be able to get more information for their work. Since it is possible to know the necessary information to meter reading data, receivable data or collection data additionally, he will be able to get more valuable information. And it will be also possible to calculate various methods by using the data of established. For example, about the age analysis which shows the receivable account in line up to an old order from the occurrence day of credit to present day, the computer system will be able to total with the various method such as house type difference, user difference, or area difference. These documents will help top management to make a good decision.

Moreover top management will be able to get the information earlier. Currently it takes long time to submit the information to top management, because most procedures are done manually, e.g. controllers write down the information into the paper, write the information into notebook and calculate them monthly. But after introduction of computer systems, the information of meter reading will be inputted into the computer on the same day, and calculation will be done by the computer system daily.

ii) Middle Management

The computer system should make personnel management more effective. Because middle management will be able to monitor the situation of meter reading or tariff collection, if he notices a problem on progress, he will be able to arrange adequate human resources easily and take action earlier. And he will be able to easily come up with strategic ideas requested from the top management.

The middle management will be able to accurately direct the plan to the subordinate staff. He should monitor the situation of meter reading and tariff collection, if he notices a problem, he will be also able to direct the action plan to the subordinate staff in charge.

And middle management will be able to communicate externally as well as internally in the section, by having the shared database. So middle management will be able to cooperate with each other across their sections.

iii) The Staff in Charge

The staff in charge will be released from complicated and tiresome jobs. The computer system will be able to conduct routine work instead of the staff, transcription of meter reading records, calculation, check easy cases. Naturally, careless mistakes will decrease and the staff can devote themselves to more important works.

If the staff is engages in not routine job but important work, the quality of work at whole Vodokanal should be improved.

3) Reduction of the Personnel Expenses

We assume the following conditions to calculate the expected personnel expenses: Meters will be installed for all users, Vodokanal will conduct meter reading once in two months, and the condition of works is the almost same as current one. The Study Team then estimates the number of meters in future. We multiply the current total number of controllers and staff at Water Sales Department according to the estimation. The estimated number of needed employees is 163.

It will be impossible to continue to work and supply appropriately service by only about 30 staff in future. The number of employees will increase, though it may not be as many as 163.

Chirchik City Vodokanal should not avoid introducing the computer system to conduct more meter reading, supply better services and improve management.

We estimate the number of tariff collection staff in 2004, when the computer systems are scheduled to complete and improvement of business procedure is done, as follows: 11 for the staff in charge of meter reading, 1 for the staff in charge of billing covering all sections, 10 for

tariff collection and 3 for overdue account control. These estimated numbers will depend on various parameters, for example, the elapse time of meter reading per one day one person, the rate of account receivable inconsistent with cash-in information from bank, rate of outstanding cases.

With proposed computer systems and tariff collection procedure, it will be possible to supply better services to user by only 25 to 35 staff. We estimate approximately USD 1.7 million* reduction of personnel expenses in ten years.

Note*: (163 - 30) x 16,000soum x 12months – 44,304soum) x 10years / 150soum = 1,699,446

8.6 Users Awareness on Water Conservation and User Participation

8.6.1 Our Recommendations for the Improvement

We identify the following objectives on our recommendation for Chirchik City Vodokanal in order to improve the present situation of Chirchik City Vodokanal.

(1) Objectives

1) To exhort users to save water and at the same time implement the metered rate system in order to decrease total annual water consumption volume to approximately half of the present level by conducting educational publicity from multilateral view points (i.e. environmental protection, efficiency of public services, economy for users, moral issues, etc.).

2) To make an earnest attempt at changing the present management system into an user participation style with Vodokanal management in order to develop both quality and efficiency of the public services on the water works sectors, and to move toward the self-supporting of Vodokanal, by introducing a mutual communication function with outsiders, such as users, and disclosing water works management in order to reflect positively valuable opinions from users for better management.

(2) Main Recommendations

We recommend 6 main proposals as follows in order to attain the objects above.

1) Establish of Public Relation section linked with the management strategy

2) Disclose issue of the annual Vodokanal's management report

3) Conduct the water conservation campaign effectively

4) School education for the young users to understand the need of water conservation in their early ages.

5) Social education & opinion forum for opinion leaders

6) Provide useful information for increasing the users' contentment

8.6.2 Key Issues of Main Proposals

(1) Establish of Public Relation Section Linked with the Management Strategy

Vodokanal should establish a public relation section (the PR section: Fig 8.6.1) in the sales division for propelling a user participation management style. The PR section should focus on corporate communication work as a function of the board of management of Vodokanal and linked with management's visions for future improvement.

1) Mission

The PR section should have two missions below.

i) To effectively conduct any corporate communication activity in order for outsiders to be able to support and understand correctly Vodokanal management messages.

ii) To hear users messages about water works and report their valuable opinions in order for Vodokanal management to give feed back for better management decisions.

2) Staff Arrangement

The PR section should have a few Vodokanal staff members to be in charge of following 3 main working functions. They had better work and cooperate with sales controllers. A manager of the PR section should supervise them to work systematically.

3) Main Working Functions

In order to achieve the mission of the PR section above, the PR section staff should devote themselves to the following 3 working functions,

i) Publicity

The publicity function should be aimed at two points. One is to make all employees understand management policies and measures that top management has decided. Another is to inform outsiders (i.e. users and government concerned, etc.) of any information Vodokanal requests so that users understand. The publicity work details are as follows:

a. Issuing annual management report

b. Providing useful information

c. Educating users

ii) Public Hearing

The public hearing function should be aimed to search for any signals from users (i.e. awareness, opinion, complain, request, etc.) about waterworks in order to reflect them in Vodokanal management policies and measures.

The public hearing work details are as follows:

a. Holding communication forum with the opinion leaders

b. Question and Answer corners

c. Checking users' sensitivity to Vodokanal message

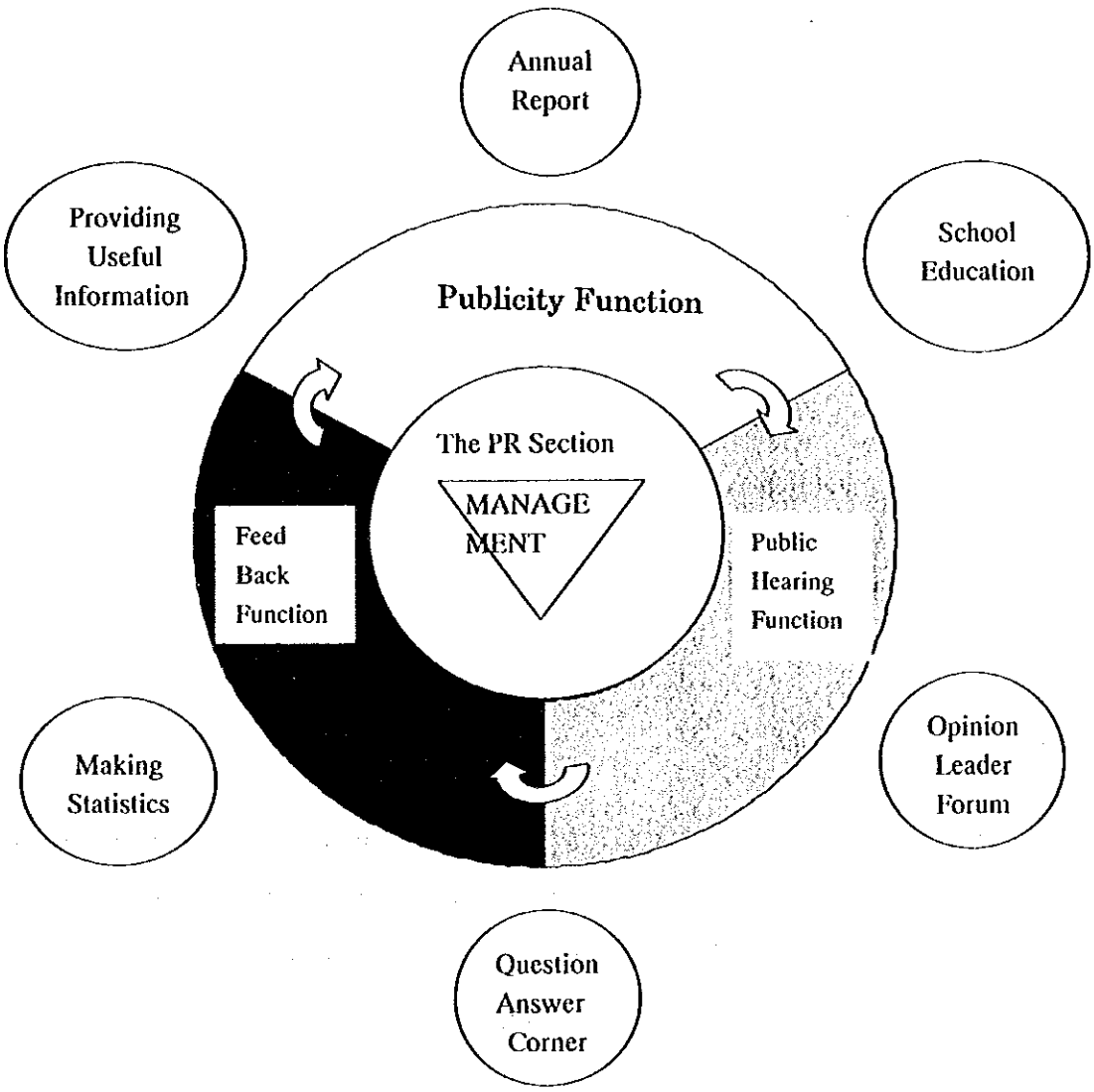
d. Monitoring users' requests of Vodokanal to improve services

iii) Feed Back to Management

The feed back function should analyze users' messages collected and make a report in order for Vodakanal management easily to find more practical ways of taking users' valuable opinions into consideration. This function also covers making statistics of users needs for future marketing or for utilizing future planing

Fig 8.6.1

The PR Section



(2) Disclose Issues of the Annual Vodokanal's Management Report

Vodokanal should issue the annual management report (Fig 8.6.2) to disclose their management.

1) Effect

We can show following effects on issuing annual report and disclose:

i) To help each manager or staff clearly understand the working mission of their own section linked with other working sections toward management vision in order to improve efficiency of projects.

ii) To promote a proud feeling for Vodokanal corporate identification among staff.

iii) To have better understanding by outsiders regarding Vodkanal's management visions and key issues on management.

iv) To promote efficiency of all staff by disclosure pressure of management performance to outsiders.

2) Contents of Annual Report

The management report should be composed of key issues on Vodokanal management as follows:

i) Management visions

Vodokanal should state their management visions what they wish to be for the next quarter century based on public missions of waterworks (i.e. the reliable waterworks that meets user demand for safe and good quality, or the environmentally friendly waterworks that delivers safe and good quality water in a fair and economical way, etc).

This also shows in brief, basic waterworks improvement policies with basic measures that Vodokanal has decided with government concerned.

ii) Present condition of the Vodokanal

Present condition should be presented as following key sections.

a. Outline of the Chirchik City Vodokanal

This shows following items in brief: organization and system of Vodokanal, general water supply data (i.e. service area, population served, water supply service ratio, total production capacity etc.).

b. Outline of facilities

This shows following items in brief: water resources facilities, purification plants, water supplying stations, transmission/ distribution facilities, service installations

c. Water quality management

This shows how Vodokanal preserves the water quality and supplies safe and good quality water.

d. Service activities

This shows following items in brief: tariff collection activities, system of water tariffs, maintenance for leakage and unexpected accident, public relations activities, etc.

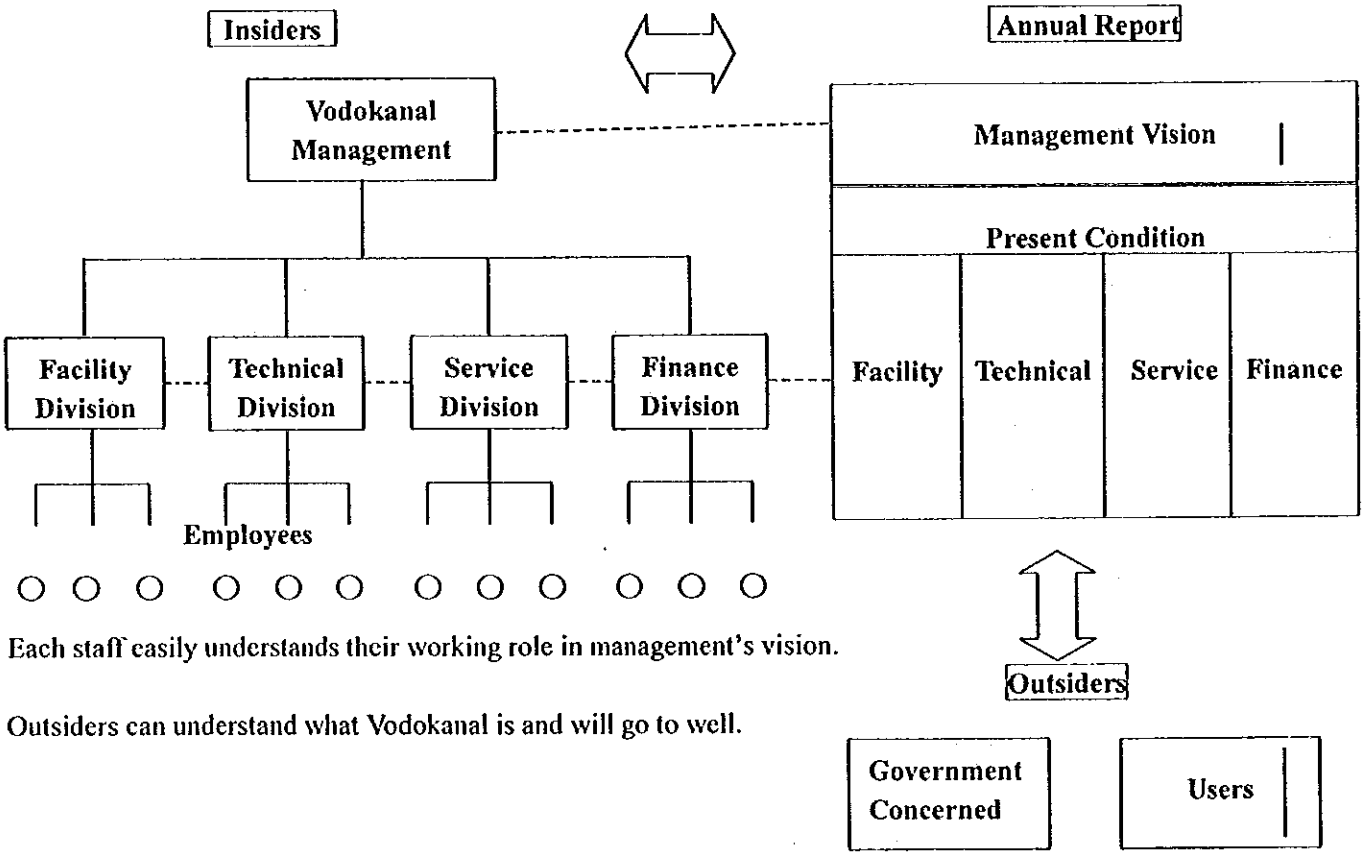
e. Technical development

This shows in brief technical development policy of Vodokanal and main achievement of technical development.

f. Finance

This shows in brief a financial system of how Vodokanal finances their management and discloses the performance of annual financial operation with the balance sheet, profit and loss statement and cash flow statement.

Fig 8.6.2 Annual Report



Each staff easily understands their working role in management's vision.

Outsiders can understand what Vodokanal is and will go to well.

(3) Water Conservation Campaign

1) Objective

Vodokanal should educate users to understand to stop wasting water and to have water conservation custom.

2) Effect

To increase financial profit from wasted water if the water can be consumed properly and charged.

To increase public social profits of environmental protection by utilize water resources properly.

3) Approach

Vodokanal should do the Water conservation Campaign by new approaches, the so-called the mixed communication style, from a more effective promotion's point of view. The campaign should be planned to conduct to well segment target area by effective mixed communication approach.

i) Target Segment

Target area of users should be divided specifically as follows:

- General Mass Users

- Opinion Leaders (See (5))

- Children aged under 16

ii) Communication Approach

The Water conservation Campaign should utilize the following communication ways respectively for the above target areas:

a. Indirect communication

Mass media (TV/radio/newspapers/poster/newsletters) are effective communication tools for sending the messages to the general mass users.

b. Direct communication

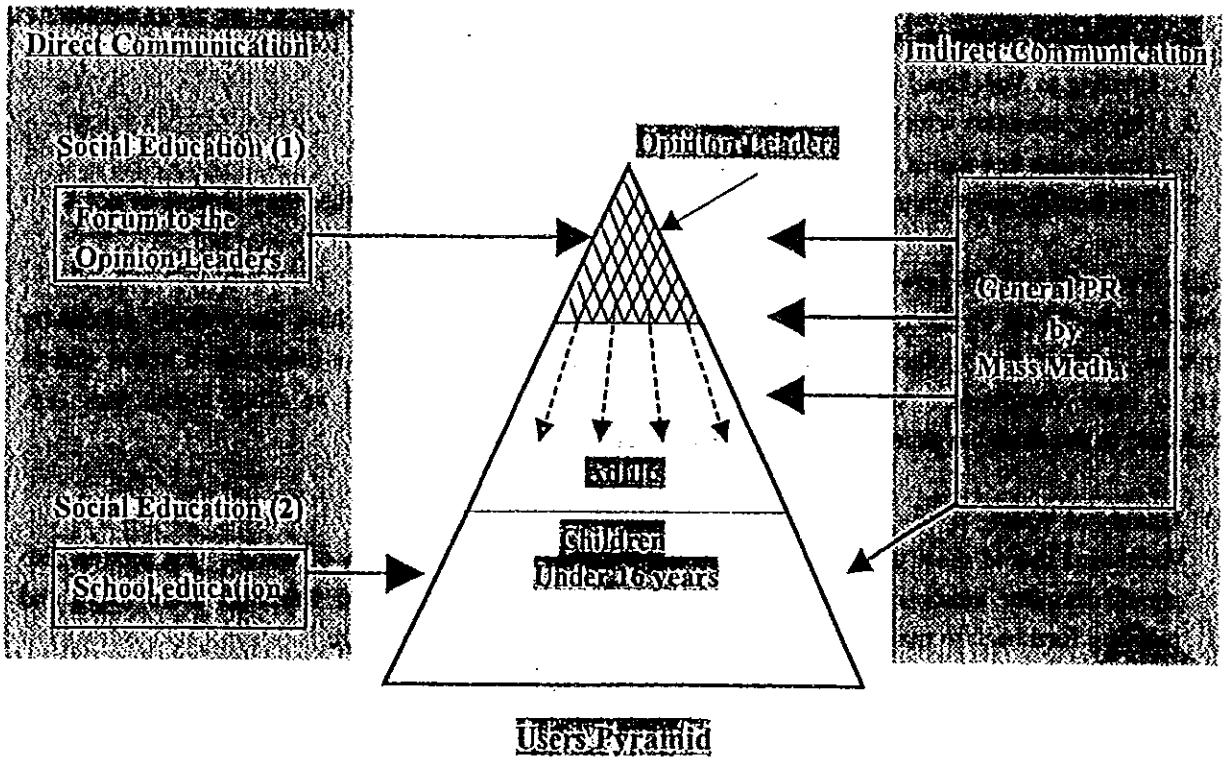
The following methods of direct communication between Vodokanal and users are effective for opinion leaders and students.

- Social education & opinion forum for opinion leaders (see (5) below)

- School education for the young users to understand the need of water conservation in their early ages (see (4) below)

Fig 8.6.3 Water Conservation Campaign

- Mixed communication style -

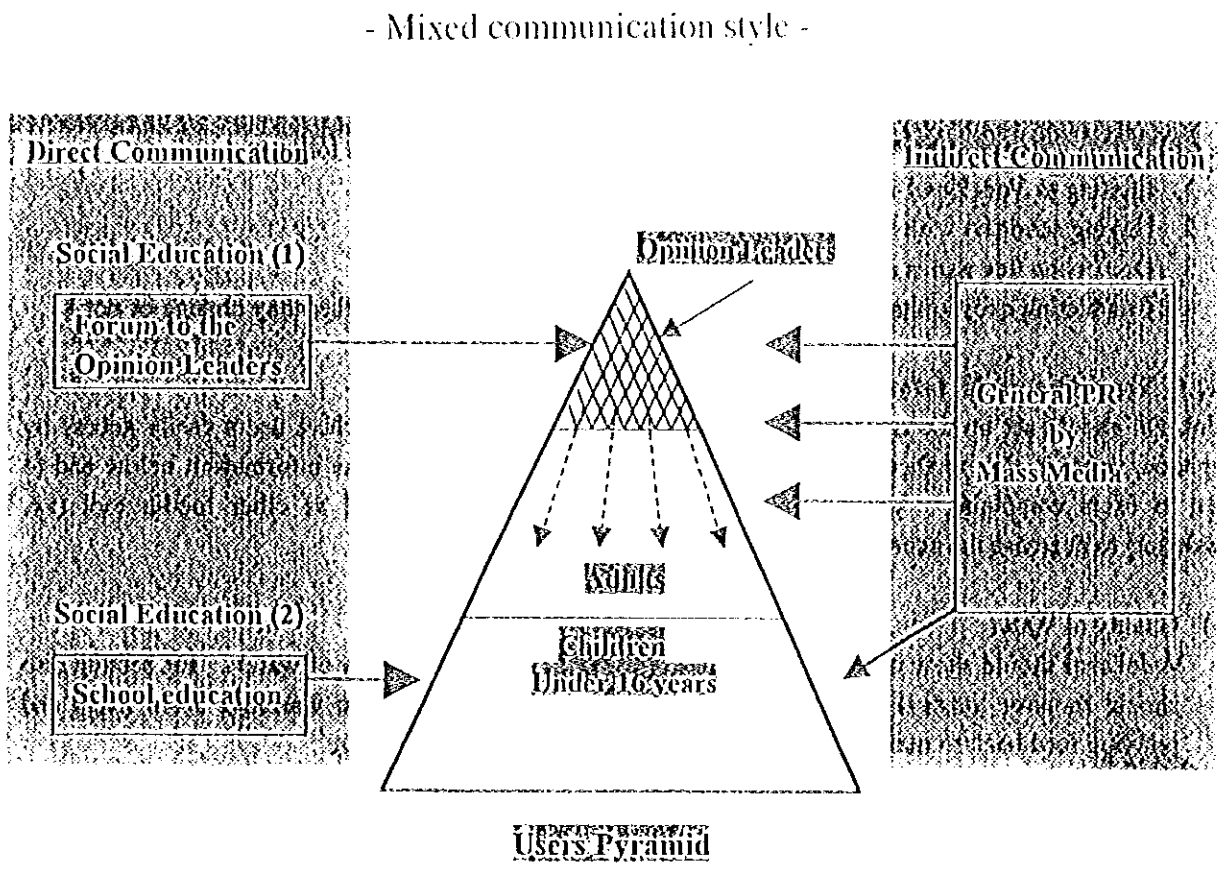


(4) School Education for the Young Users

Vodokanal PR staff should visit secondary schools to have lectures about waterworks and water conservation issues for younger users to understand the social public interests.

Vodokanal should also invite secondary students to their water supply facilities to help them understand how to make water supply, how much it costs to make supplied water from natural resources (such as rain, snow and under ground water), and how necessary water conservation is for the protection of earth's environment, as well as, for our social benefits.

Fig 8.6.3 Water Conservation Campaign



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(5) Social Education & Opinion Forum for Opinion Leaders

Vodokanal should hold social education forum or opinion forum for opinion leaders. It is important to make opinion leaders understand the key issues of Vodokanal management. The opinion leader is defined as a leader of a social group who can influence members' opinions or minds through daily direct communication. In case of Tashkent city, the opinion leaders may be considered to be chiefs of Makhallinsky committee for residents in local area, companies' directors for employees, school teachers for children, parents for family members, and so on. If these opinion leaders understand the need of water conservation and are willing to do, other members of his or her society, family, company will follow his or her behaviors. The opinion leaders' actions to save water will impact on whole existing users to cooperate to save water.

The social education forum for opinion leaders can be arranged for examples as follows:

1) Inviting to Vodokanal facilities

2) Having seminars with video

3) Discussing key issues and exchange opinions

4) Conducting questionnaire surveys to get their opinions (for check whether they change or not)

(6) Providing Useful Information for Increasing the Users' Content

Vodokanal should set up the question & answer corners on the PR section where users easily access by telephone, internet, face to face talking, in order to provide useful water works information below and to listen to users complains. Vodokanal should utilize this function as well as other media tool (i.e. news letters) to decrease the users' discontent, and to increase their contentment.

1) Quality of Water

Vodokanal should show users the results of the examination of the quality of water. PR section also should monitor unusual issues on the quality of water by listening to warnings from users and relaying feed back to management to reduce water work loss in early stage.

2) Stability of Water Supply

The PR section should announce the schedule of the water supply construction, and warn about the interruption of supplied water to users in advance.

8.7 Water Supply System and Operation and Maintenance

8.7.1 Present and Future Problems and Countermeasures

Present and future problems and countermeasures are presented in Table8.7.1.

(1) Present Problems

1) WTPs and Intake plants

Present problems of WTPs are described below:

- Primary automation is not yet introduced.
- Majority of facilities are deteriorated.
- Most of the flow meters are not working.
- Most of the electric facilities are out of order.
- Reservoirs at WTPs and distribution system are too small, are retention time of them is also too short.
- Repair and improvement budget of Chirchik Vodokanal is too small, and that lead to difficulty for proper repair, replacement and improvement.
- Electricity cost of distribution pump station is very high.

2) PSs

Present problems of PSs are described below:

- Majority of facilities are deteriorated.
- Boosted water is directly distributed to consumer resulting in inefficiency.

3) Pipelines

Present problems of pipelines are described below:

- Many pipes and accessories are deteriorated and are not repaired properly due to lack of budget.
- Majority of pipes are steel pipe which is easily rusting material.
- Inner lining is not provided for steel pipes resulting these pipes easily rust.
- "Faucet Joint" which causes leakage easily, is adopted for connection of cast iron pipe.
- Pipeline repair and improvement budget is insufficient.
- Distribution pressure to consumer is improper that is too high as of more than 5 kg /sq.cm or too low less than 1 kg/sq.cm.

Table 8.7.1 Present and Future Ploblems and Couentermeasures

Object	Name	Problems			Countermeasures
		Present Problems		Future Problems	
		Common	Individual	Common	Common
WTP	Surface	-Primary Automation is not yet introduced -Majority of facilities are deteriorated -Most of the flow meters are none operational -Most of electric facilities are out of order -Detention time of reservoir is not enough -Repair and improvement budget is insufficientl	-Accutual production volume is exceeding the nominal capacity -Most of raw water do not treated by filter in summer season	-Huge budget of repair and replacement shall be needed in near future -If water demand decreases, operation of WTPs will be very difficult to the fluctuation in water distribution volume -If electricity caharge will be risen cost of water supply will sharply increase because of large consumption of electricity	-Reduction of distribution volume by reduction of water leakage and saving water -Electricity cost must decrease by gravity flow of distribution. -Abolition of WTPs with small capacity by deduction of distribution volume -Construction and Expantion of reservoirs -Introduction of Automatic operation systm - Installtion of flow/pressure meters
	No.1 Intake		-Electricity cost is very high -Accutual production volume is sharply short to nominal capacity		
	No.3 Intake		-Accutual production volume is exceeding the nominal capacity - Electricity cost is high		
	No.6 Intake		-Electricity cost is high - Quarity of groundwater is bad to the critera of Uzbekistan		
PS	No.2 PS No.4 PS	-Majority of facilities are deteriorated -Electricity cost is high	-Distribution pressure is too high -Boosting directly to consumer -Unstable operation by directly sucking from pipes	-If gravity distribution and proper rearrangement of distribution pipes will be introduce these PSs will not be needed	-Abolition of unnecessary PSs by gravity distribution
Pipelines	Tansmission	-Many pipes and accessories are deteriorated and are not repaired properly -Majority of pipes are steel pipe that is easily rusted -Inner lining is not installed for these steel pipes -"Faucet Joint" which causes leakage easily, is adopted for connection of cast iron pipe. -Repair and improvement budget is insufficient -Many leakage points -Water quality is derteriorated by rust of steel. -Improper pressure to consumer: too high or too low -Repair and improvement budget is insufficient	-All pipes are steel pipe	-Water leakage will increase and huge budget for repair and replacement will be needed in near future -Complaint for rusty water, interruption of water and other will increase because of risen tariff -Water leakage and interruption will be increased by deteriorated pipes	-Replacement of pipes -Installation of inner lining -Plastic pipe shall be adopted in small diameter pipes -Pipeline replacement and budget shall be prepaired
	Distribution		-Many old pipes is exist but did not replace -Pipe diameter is improper -Gravity ditribution was not introduced		
O&M	WTPs PSs Pipelines	-Many operational staffs are needed for manual control -Plants are not operated properly without grasping the necessary operational information, such as flow, pressure, etc. - Repair and improvement budget is insufficient	-Many operational staffs are needed -Distribution volume is not monitored because operater donot -Operater donot grasp proper operationanl imformation -Lack of machines and equipment and materials for repair	-Proper operation is very difficult due to be lack of needed information -Unstable operation by manual oprartion system	-Automatic operation system shall be introduce -Installation of observation equipment such as, flow/pressure meter and water level indicator in reservoir
Consumer	Individual Communal Service Industry Hot water and Heating water	-People awareness fowords the importace and benefit of water supply system is very scarce -People's "Save water" consiousness is very poor, due to cheap water tariff and to the non meter-rate system	-Exisisting water meters are very few - Water tariff is cheap -Water tariff is relatively cheap -Aggressive saving waters activities are not conducted -Non-metered consumer still exist -Aggressive saving water activities are not conducted -Systems and facilities are deteriorated -Heating water was drained because of equipments of consumer are not proper working	-By meter-rate system and new tariff table, water charge will be sharply risen especially in water leaking houses -People must repair their water leaking points	-Installation of water meters shall be pushed strongly -Repair of leaking equipment and pipes -Loan arrangement for repair works -Preparation of criteria for water meter and accessaries, installation method, etc. -Adoption of Plastic pipes -Installation of water meters for hot water -Introduction of disciplinary tariff system -Water saving campaign by Vodocanal shall be conducted

- Although many leakage points exist in pipeline network, these can not be repaired properly.
- The water quality aggravated by the rust of steel pipes.

4) O&M

Present problems in O&M are described below:

- Many operational staffs for manual control.
- Operator of Plants are not grasping operational information such as flow volume, distribution pressure and storage volume of reservoir with real time therefore plants are not operated properly.
- Repair and improvement budget of Chirchik Vodokanal is too small and repair and improvement works are not be conducted properly.
- Machines, equipment and materials for repair is always insufficient

5) Water Consumer

Present problems of consumer are described below:

- In spite of huge water leakage at houses and buildings, people do not repair it because most of the them are not adopted the meter-rate system and water charge is very cheap. If they repair the leakage, the water charge of them shall be the same.
- People are wasting water because of cheap tariff and the non meter-rate system.
- People did not notice the significant of problem of water leakage and waste.

(2) Future problems

1) WTPs

Expected future problems of WTPs are described below:

- Huge budget of repair and replacement will be needed in near future.
- If water demand decreases, operation of WTPs will be very difficult to deal with hourly demand fluctuation.
- If electricity charge will be risen, cost of water supply cost will sharply increase because of large consumption of electricity.

2) PSs

Anticipated future problems of PSs are described below:

- If gravity distribution and proper rearrangement of distribution pipes will be introduce these PSs will not be needed.

3) Pipelines

Future problems of pipelines will be as follows:

- Water leakage will increase and huge budget of repair and replacement will be needed in near future.
- Complaint for rusty water, interruption of water and other will increase because of risen water charge.

-Water leakage and interruption will be increased by deteriorated pipes.

4) O&M

Supposed future problems of O&M are described below:

-Proper operation is very difficult due to the lack of needed information such as flow volume, water pressure, storage volume of reservoirs and other.

-Unstable manual operation system.

5) Water Consumer

Supposed future problems of consumer are described below:

-By meter-rate system and new tariff table, water charge will be sharply risen especially for owner of the water leaking house.

-Therefore, people must repair their leaking water equipment and pipes

(3) Countermeasures

1) WTPs

Proposed countermeasures for problem in WTPs are described below:

- Deduction of distribution volume will be realized by repair of water leakage at houses and buildings, by repair of distribution pipelines and by saving water.

- Distribution system by gravity should be introduced.
- When distribution volume in Chirchik City decreases, some small capacity Intakes can be abandoned.
-The volume of reservoirs in Chirchik City should be enlarged and constructed.
-Automatic operation system should be introduced at operation of pumping and other.
- Measuring equipment of distribution flow, water pressure in the city, and water level of reservoirs should be installed and these data can be observed in WTPs.

2) PSs

Proposed countermeasures for problem in PSs are described below:

- Two PSs should be abandoned because of Introduction of gravity distribution.

3) Pipelines

Proposed countermeasures for problems in pipelines are described below:

-Replacement of pipes should be facilitated.
-Replacing pipes should have inner lining.
-Plastic pipe should be adopted for small diameter pipes.
-Pipeline replacing plan should be prepared, budget should be ensured and replace budget will be need.
- Improvement for gravity distribution should be conducted.

4) O&M

Proposed countermeasures for O&M problems are described below:

-Automatic operation system should be introduced.
-The observation equipment for measurement of distribution flow, pressure, storage volume of reservoir should be installed

5) Water Consumer

Proposed countermeasures for problems in consumer are described below:

-Installation of water meters should be promoted strongly.

-Repair of leaking equipment and pipes should be pushed strongly.

-Loan arrangement for repair works should be prepared.

-Criteria for selection of proper water meters and accessories, proper installation method, installation place should be instituted.

-Plastic pipes should be used for housing water pipes.

-Water meters for hot water should be installed.

-Disciplinary tariff system should be introduced.

-Saving campaign by Vodokanal should be conducted.

8.7.2 Proposed Improvement Plan

Proposed Improvement Plan for Water Supply System in Chirchik City is presented in Table 8.7.2.

The major points of recommendation are described below:

- Reduction of the water supply volume.
- Countermeasures for water leakage reduction and prevention of water wasting.
- Estimation on effect by water supply volume reduction and systems improvement.
- Improvement of system, facilities and O&M.
- Estimation of the necessary cost for countenmeasures and other.

(1) Reduction of Water Supply Volume

It was estimated that water consumption (including leakage and waste) in Chirchik City was too high and therefore, distribution volume should be decreased sharply.

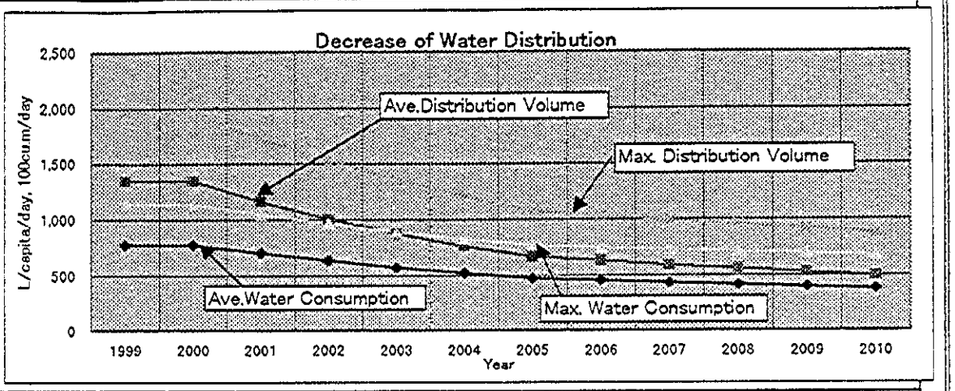
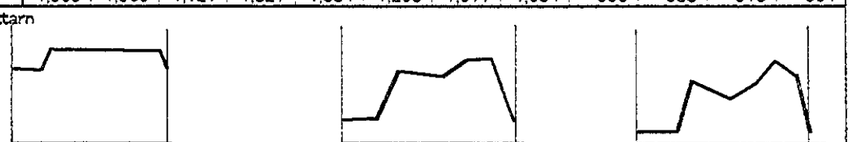
As the result of the water demand survey by the Team for detached house in Tashkent City (See chapter 5.2), water consumption of individual can be sharply decreased by introduction of meter-rate system.

Individual of occupied apartment and large consumer can be also decreased by introduced the meter-rate system and disciplinary tariff system because of this result.

1) Reduction of Distribution Volume

Base of reduction is shown in Table 8.7.3 and is explained below.

Table 8.7.2 Proposed Improvement Plan of Water Supply Systems in Chirchik City

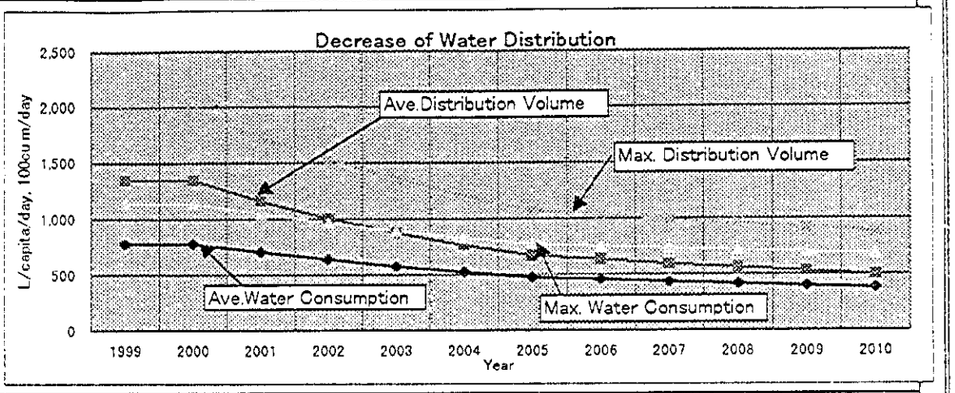
Year				1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Decreasing Plan															
Served Population			X1000	146	146	149	152	155	158	161	164	168	171	174	178
Item			Units				Assumptive Value								
Water Consumption	Apartment	Average:496*0.743	L/capita/day	369	369	316	271	233	199	171	164	156	150	143	137
		Maximum:700*0.743		520	520	430	356	294	243	201	192	184	176	168	161
	Detached House	Average:496*0.257		127	127	121	114	109	103	98	94	90	86	82	78
		Maximum:750*0.257		193	193	161	134	111	93	77	74	71	67	64	62
	Hot/Heating Water	Average:7,777/146		52	52	50	48	45	43	42	40	38	36	35	33
		Maximum: Ave.*1.0		52	52	50	48	45	43	42	40	38	36	35	33
	Communal Service	Average:8,632/146		59	59	56	54	52	49	47	45	43	41	39	38
		Maximum:Ave.*1.5		89	89	85	81	78	74	71	68	65	62	60	57
	industry	Average:10,624/146		73	73	70	67	64	61	58	56	53	51	49	47
		Maximum:Ave.*1.5		110	110	105	101	96	92	88	84	80	77	74	70
	Water Leakage	Average		97	97	88	79	71	64	58	56	53	51	49	47
		Maximum		378	378	329	286	249	217	189	171	154	139	126	113
	Total	Average		777	777	701	633	574	521	474	454	434	415	397	380
		Maximum		1,342	1,342	1,160	1,005	874	763	668	629	592	558	526	497
Distribution Volume(Ave.)		Average	100cu.m/day	1,134	1,134	1,043	962	889	823	765	746	728	710	692	675
		Maximum		1,960	1,960	1,727	1,527	1,354	1,205	1,077	1,034	993	955	918	884
Flow Pattarn			Flow	Flat Pattarn 											
Counter Measures	Decrease of Leakage	Apartment	—	← Repair of Pipes & Equipments →											
		Detached House		← Repair of Pipes & Equipments →											
		Communal Service		← Repair of Pipes & Equipments →											
		Enterprise		← Repair of Pipes & Equipments →											
		Hot Water & Heating		← Repair of Pipes & Equipments →											
		Distribution pipes repair	—	← Leakage detection, Quick repair, Replace of pipes →											
	Saving	Apartment	—	← Campaign →											
		Detached House		← Installation of meter →											
		Communal Service	—	← Campaign, Disciplinary Tariff →											
		Enterprise	—												
		Hot Water & Heating	—	← Campaign, Disciplinary Tariff →											
		WTP & PS	—	← Improvement of system and O&M →											
Cost of Counter-Measures	Decrease of Leakage	Apartment	10^6sum			7.3	7.3	7.3	7.3	7.3					
		Detached House				10.3	10.3	10.3	10.3	10.3					
		Communal Service				2.1	2.1	2.1	2.1	2.1					
		Enterprse				1.3	1.3	1.3	1.3	1.3					
		Hot Water & Heating				1.8	1.8	1.8	1.8	1.8					
		Distribution pipes repair				Included Running cost									
		WTP & PS				3	3	3	3	3					
		Total				26	26	26	26	26	0	0	0	0	0
	Saving	Campaign				3	3	3	3	3	3	3	3	3	3
		Meter instalation			135	135	135	135	135						
		Total			135	138	138	138	138	3	3	3	3	3	3
Effect	Staff Arrangement	Addministration	Number	72	72	72	72	72	72	72	72	72	72	72	72
		O&M of Facilities		126	126	126	126	126	126	126	114	102	92	83	75
		Water Network		27	27	27	27	27	27	27	27	27	27	27	27
		Service & sales		23	24	25	26	28	30	30	30	30	30	30	30
		Construction & Repair		47	47	55	60	60	60	60	60	60	60	60	60
		Total		295	296	305	311	313	315	315	303	291	281	272	254
		Surplus Workers*1		0	0	−9	−15	−17	−19	−19	−7	5	15	24	32
	Running Cost	Chemicals & Electricity	10^6sum/y	105.6	105.6	94	83	74	65	58	51	46	40	36	31.8
		Repair & Improvement	%	100	100	100	96	93	90	87	84	81	78	75	70
	Simplification of Facilities	Abandonment of WTP	—							No.3	No.6				
		Working PS		2	2	2	2	0	0	0	0	0	0	0	0
		Pipe Line								Need of replace and abandon					
		Cost	10^6sum/d				20			30	30				
	Others	Water Resource Water Intake Volume	10^3cu.m/d		113	104	96	89	82	76	75	73	71	69	68
Needed Improvement of Systems	Contents	WTP	—				← Automatic Improvement of Pumps								
		PS					Abolotion								
		Pipe Line (include Replac	Km				5(D400)	3	3	3	3 3+2		4	4	5
		Reservoir Construction	cu.m				8,000					4,000			
	Cost	WTP	1000$/y				3,310								
		PS					0								
		Pipe Line					2,000	600	600	600	600	1,400	800	800	1,000
		Reservoir					2,210					1,180		0	
		Total				0	7,520	600	600	600	600	2,580	800	800	1,000
Total Cost		Investment	10^6sum			23	23	23	23	23			0	0	0
		〃 by Vodocanal	10^6sum	0	135	141	141	141	141	36	33	3	3	3	3
		〃 by Vodocanal	1000$			0	7,520	600	600	600	600	2,580	800	800	1,000
		Running Cost	10^6sum/y	106	106	94	83	74	65	58	51	46	40	36	32

*1:Surplus Worker can rearrenge for construction.

Role of Vodokanal

Table 8.7.2 Proposed Improvement Plan of Water Supply Systems in Chirchik City

Decreasing Plan



Year				1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Served Population			X1000	146	146	149	152	155	158	161	164	168	171	174	178
Item			Units				Assumptive Value								
Water Consumption	Apartment	Average:496*0.743	L/capita/day	369	369	316	271	233	199	171	164	156	150	143	137
		Maximum:700*0.743		520	520	430	356	294	243	201	192	184	176	168	161
	Detached House	Average:496*0.257		127	127	121	114	109	103	98	94	90	86	82	78
		Maximum:750*0.257		193	193	161	134	111	93	77	74	71	67	64	62
	Hot/Heating Water	Average:7,777/146		52	52	50	48	45	43	42	40	38	36	35	33
		Maximum: Ave.*1.0		52	52	50	48	45	43	42	40	38	36	35	33
	Communal Service	Average:8,632/146		59	59	56	54	52	49	47	45	43	41	39	38
		Maximum:Ave.*1.5		89	89	85	81	78	74	71	68	65	62	60	57
	industry	Average:10,624/146		73	73	70	67	64	61	58	56	53	51	49	47
		Maximum:Ave.*1.5		110	110	105	101	96	92	88	84	80	77	74	70
	Water Leakage	Average		97	97	88	79	71	64	58	56	53	51	49	47
		Maximum		378	378	329	286	249	217	189	171	154	139	126	113
	Total	Average		777	777	701	633	574	521	474	454	434	415	397	380
		Maximum		1,342	1,342	1,160	1,005	874	763	668	629	592	558	526	497
Distribution Volume(Ave.)		Average	100cu.m/day	1,134	1,134	1,043	962	889	823	765	746	728	710	692	675
		Maximum		1,960	1,960	1,727	1,527	1,354	1,205	1,077	1,034	993	955	918	884
Flow Pattarn			Flow	Flat Pattarn											
Counter Measures	Decrease of Leakage	Apartment	---	← Repair of Pipes & Equipments →											
		Detached House		← Repair of Pipes & Equipments →											
		Communal Service		← Repair of Pipes & Equipments →											
		Enterprise		← Repair of Pipes & Equipments →											
		Hot Water & Heating		← Repair of Pipes & Equipments →											
		Distribution pipes repair	---	← Leakage detection, Quick repair, Replace of pipes →											
	Saving	Apartment	---	← Campaign →											
		Detached House		← Installation of meter →											
		Communal Service	---	← Campaign, Disciplinary Tariff →											
		Enterprise	---												
		Hot Water & Heating	---	← Campaign, Disciplinary Tariff →											
		WTP & PS	---	← Improvement of system and O&M →											
Cost of Counter-Measures	Decrease of Leakage	Apartment	10^6sum			7.3	7.3	7.3	7.3	7.3					
		Detached House				10.3	10.3	10.3	10.3	10.3					
		Communal Service				2.1	2.1	2.1	2.1	2.1					
		Enterprse				1.3	1.3	1.3	1.3	1.3					
		Hot Water & Heating				1.8	1.8	1.8	1.8	1.8					
		Distribution pipes repair				Included Running cost									
		WTP & PS				3	3	3	3	3					
		Total				26	26	26	26	26	0	0	0	0	0
	Saving	Campaign				3	3	3	3	3	3	3	3	3	3
		Meter instalation			135	135	135	135	135						
		Total			135	138	138	138	138	3	3	3	3	3	3
Effect	Staff Arrangement	Administration	Number	72	72	72	72	72	72	72	72	72	72	72	72
		O&M of Facilities		126	126	126	126	126	126	126	114	102	92	83	75
		Water Network		27	27	27	27	27	27	27	27	27	27	27	27
		Service & sales		23	24	25	26	28	30	30	30	30	30	30	30
		Construction & Repair		47	47	55	60	60	60	60	60	60	60	60	60
		Total		295	296	305	311	313	315	315	303	291	281	272	264
		Surplus Workers*1		0	0	-9	-15	-17	-19	-19	-7	5	15	24	32
	Running Cost	Chemicals & Eectricity	10^6sum/y	105.6	105.6	94	83	74	65	58	51	46	40	36	31.8
		Repair & Improvement	%	100	100	100	96	93	90	87	84	81	78	75	70
	Simplification of Facilities	Abandonment of WTP	---							No.3	No.6				
		Working PS		2	2	2	2	0	0	0	0	0	0	0	0
		Pipe Line								Need of replace and abandon					
		Cost	10^6sum/d				20			30	30				
	Others	Water Resource Water Intake Volume	10^3cu.m/d		113	104	96	89	82	76	75	73	71	69	68
Needed Improvement of Systems	Contents	WTP	---				← Automatic Improvement of Pumps								
		PS					Abolotion								
		Pipe Line (include Replac	Km				15(D400)	3	3	3	3	3+2	4	4	5
		Reservoir Construction	cu.m				8,000					4,000			
	Cost	WTP	1000$/y				3,310								
		PS					0								
		Pipe Line					2,000	600	600	600	600	1,400	800	800	1,000
		Reservoir					2,210					1,180		0	
		Total				0	7,520	600	600	600	600	2,580	800	800	1,000
Total Cost		Investment	10^6sum			23	23	23	23	23			0	0	0
		// by Vodocanal	10^6sum	0	135	141	141	141	141	36	33	3	3	3	3
		// by Vodocanal	1000$			0	7,520	600	600	600	600	2,580	800	800	1,000
		Running Cost	10^6sum/y	106	106	94	83	74	65	58	51	46	40	36	32

*1:Surplus Worker can rearrenge for construction.

Role of Vodokanal

- Consumption of apartment buildings and detached house including large volume of leakage are shown Table 6.3.5.

Table 8.7.3 Base of Reduction of water consumption

Item		2000			2005			2010	
		Sym-bol	Base L/cap/d	Rate %	Sym-bol	Base L/cap/d	Rate %	Base L/cap/d	rate %
Apart	Ave.	a	496*0.743	47.3	b	230*0.743	35.9	b*0.8	35.9
	Max.	c	700*0.743	38.7	d	270*0.743	30.1	d*0.8	32.4
Detached	Ave.	e	496*0.257	16.3	f	380*0.257	20.6	f*0.8	20.6
	Max.	g	750*0.257	14.4	h	300*0.257	11.5	h*0.8	12.4
Hot/Heating Water	Ave.	q	7,777/146	6.7	r	q*0.8	8.7	r*0.8	8.7
	Max.	s	q*1.5	3.9	t	s*0.8	6.2	s*0.8	6.7
Communal Service	Ave.	I	8,632/146	7.6	j	I*0.8	9.9	J*0.8	9.9
	Max.	k	I*1.5	6.6	l	k*0.8	10.7	I*0.8	11.5
Industry	Ave.	m	10,624/146	9.4	n	m*0.8	12.3	n*0.8	12.3
	Max.	o	m*1.5	8.2	p	o*0.8	13.2	P*0.8	14.2
Water Leakage	Ave.	u	Total-(a+e+I+m+q)	12.8	v	u*0.6	12.6	v*0.8	12.6
	Max.	w	Total-(c+g+k+o+s)	28.2	x	w*0.6	28.3	x*0.8	22.8
Total	Ave.		Ave.total	100.0		Ave.total	100.0	Ave.total	100.0
	Max.		Max.total	100.0		Max.total	100.0	Max.total	100.0

Repair work of water supply system should be conducted during 2000 till 2005. Reduction volume by this repair and saving volume till 2005 are estimated as leakage volume in Table 6.3.5.

- Maximum distribution volume is calculated by measured Value of the study.
- Communal service must have relatively low volume of leakage at buildings and waste in Chirchik because all of these building was installed meters and these water consumption were low rate to total consumption volume. Therefore only 20 % of distribution volume will be decreased untill 2005.
- Only 20 % of distribution volume is also estimated to be decreased for industries.
- It is said that heating water is drained because of equipment of consumer are not proper working, but water consumption volume by hot and heating water is low.

  Therefore, hot and heating water systems can be decreased to 20% untill 2005.
- Water leakage rate of pipeline network is relatively low, but leakage volume per capita, 97L/capita/day is large. Therefore Vodokanal shall conduct water leakage detection and rapid repair. Water distribution volume can be sharply decreased as shown Table 8.7.2 by conduction of aforementioned countermeasures.

2) The Countermeasures for Reduction of Water Leakage and Saving Water

i) Introduction of Loan System for Repair

- When meter-rate system and disciplinary tariff system is introduced to detached houses and apartment, which consume large volume of water, must pay expensive water charge.
- Therefore, water wasting shall be stopped immediately and water leakage from water equipment and pipes must repair. Thus, people must pay the repair cost but many people can not afford to pay. If people can not repair water leakage and must pay expensive charge, they will complain of that strongly.
- Thus when meters are installed, leaking pipes and equipment whithin houses and buildings must be repaired for saving water rapidly. However some repairs will be costy, therefore introduction of loan system will be needed for efficient repair works.

ii) Repair of Pipes and Equipment in Buildings and Houses

- Leaking units at Apartment buildings are estimated as below:

  Average Water consumption (as Consumption on November): 500L/capita/day

  Leakage from Toilet 3L/min*1440min/day/2.75capita=1,570L/capita/day

  Real consumption as assumed: 230L/capita/day

  Leaking unit rate: (500-230)/1570*100=17.2%---20%

- Several detached houses are consuming very large volume.

  Rate of these houses is estimated as 10 to 20%. It is supposed that water leakage in these houses occurs in toilet or pipes.

- Most of the toilets of buildings of communal service are leaking water thus these toilet and pipes they shall be repaired immediately.
- Water tariff for industry is relatively high and most of them were equipped with water meter.

  Therefore it is supposed that majority of industries already repaired pipes and water equipment, and were saving water. But some leakage pipes and equipment are remained as they are because of poor installation and low equipment quality.

iii) Repair of Distribution and Transmission Pipes

- Though pipelines have many leakage points, they were not repaired rapidly due to lack of water leakage detection equipment.

iv) Saving Water

- Introduction of meter-rate system is the most effective measure for saving water according to the result of water demand survey. Proper water meters shall be selected be installed by appropriate method.
- Vodokanal shall accelerate campaign for saving water.
- Disciplinary tariff system shall be introduced.
- Water meters for hot water shall be installed

(2) Estimate of Effect by Reduction of Water Supply Volume

1) Rearrangement of Plants and Facilities

- Some Intakes will be unnecessary if distribution volume is deducted.

The actual capacity of Chirchik Surface WTP and No.1 Intake are 59,000 and 50,000 cu.m/day (total 109,000cu.m/day) respectively, therefore, as shown in table 7.7.2 in 2005, another WTP will be unnecessary because maximum distribution volume will be 107,700 cu.m/day.

- In 2005, maximum total distribution volume will be deducted to 108,000/196,000= 55%.

The cite of Chirchik WTP is the Highest elevation as of elevation 670m, the elevation of high level district is as of 620 to 650 m, the middle level district is as of 600 to 610m and the lowest level district is as of 570 to 580m.

- Therefore the service reservoir shall be located at level of about 670m, 630m, and 600m respectively. And each districts shall be distributed from each proper level service reservoir by gravity. Thus almost all area of the city can be distributed by gravity.

The plan of location is shown in Figure 8.7.1.

2) Rearrangement of Staffs

Staff rearrangement plan is shown in Table8.7.2.

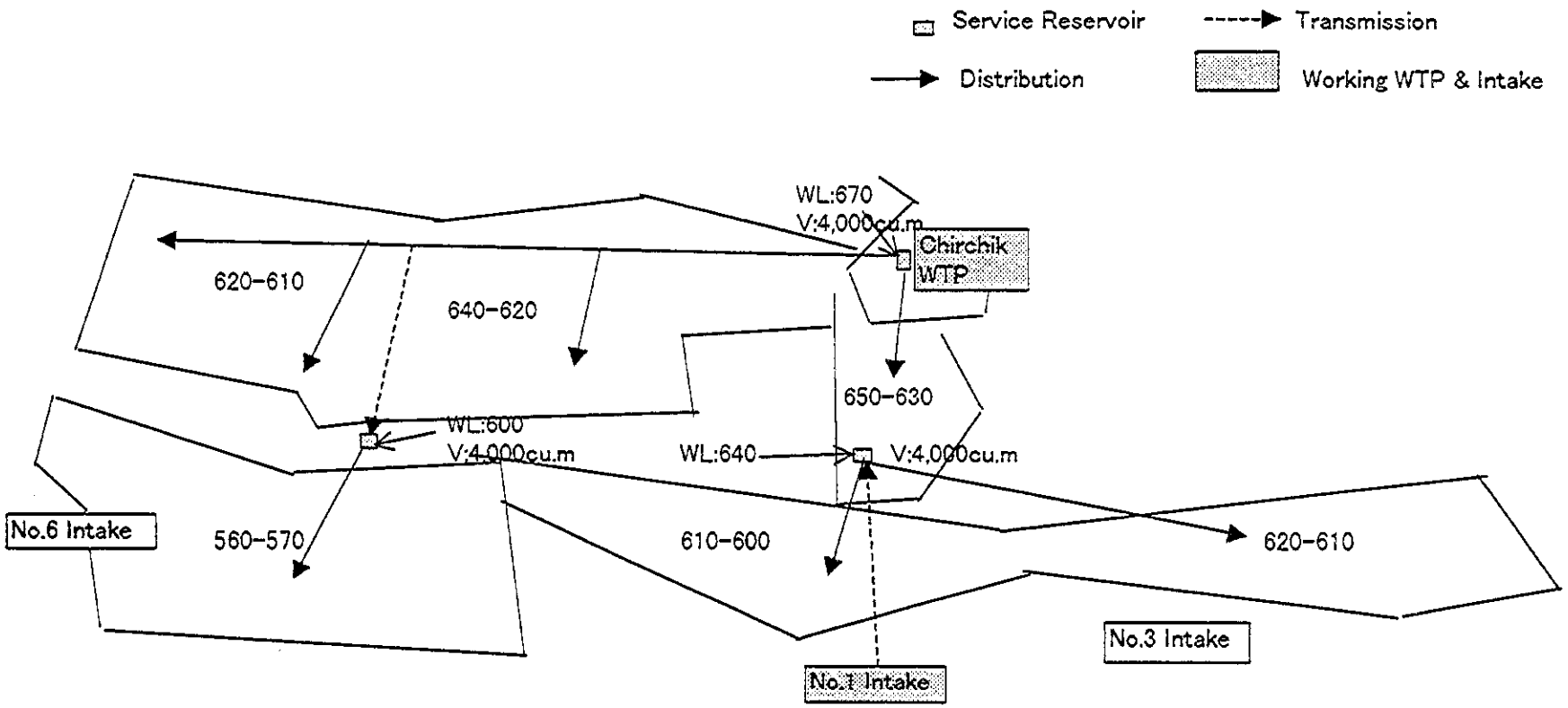


Figure 8.7.1 Location of Reservoirs and Plants in Chirchik City

- The number of staff for water supply systems is 295 while that for O&M of plants is 126. Due to the abolition of the plants these O&M member will be decreased.
- The budget of repair, improvement and replace shall be increased and these staff shall be increased.
- The staffs of service and sales department shall be increased for meter reading and others.

3) Running Cost

i) Chemicals and Electricity

- Chemicals and Electricity cost were estimated as approximately 105.6 million Sum in 1999. Chemicals cost were 9.7 million Sum when distribution volume was 95.9 million cu.m.
- Distribution volume ratio is assumed as 75 % of for Chirchik WTP and 25% for No.1 Intake in 2010.
- The chemical cost in 2010 is calculated as below.

  (0.32 x 0.75+0.1 x0.25) Sum/cu.m x 24.8million = 6.6 million Sum
- The electricity cost in 2010 is calculated below.

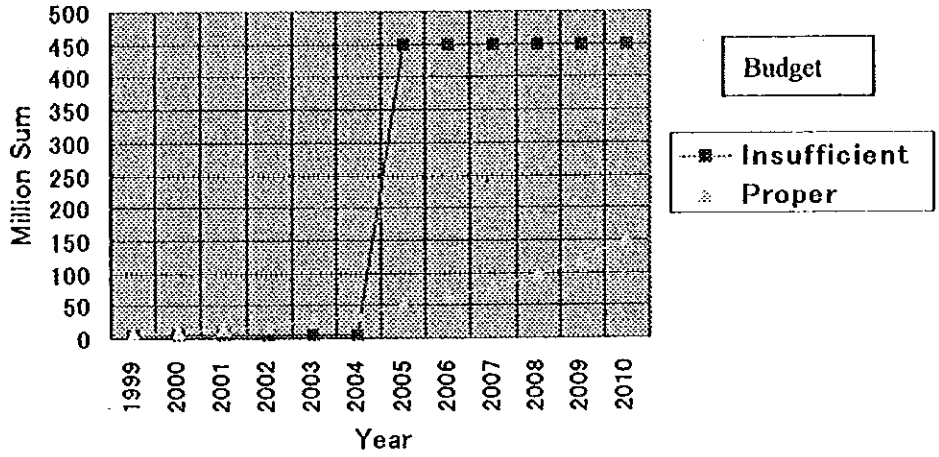
  (0.3kwh x 0.75+0.5 x 0.25) x 2.9sum/kwh x 24.8million =25.2 million Sum
- Total cost of Chemicals and Electricity is 6.6+25.2=31.8 million sum in 2010, and is 31.8million/ 105.6million = 30 % to the cost in 1999.

ii) Repair, Improvement and Replace Cost

- Water supply cost was about 1.7 dollar per cu.m, and repair cost and repayment of loan is about 8 % and 20% to total budget in Japan as of 1997 (source: Water Supply Statistics). This loan repayment is for the cost of system enlargement, improvement and replacement in Japan. The average repair cost is 0.12 dollar per cu.m.
- If needed repair cost of Tashkent is assumed as 20% to Japanese level, it will be 41.4million cu.m x 0.2 x 0.12dollar x 150 sum/dallar=150 million Sum/year. It corresponded to 60 % to total budget of about 250 million Sum and will not be applicable. However annual budget for repair, improvement and replace works shall be secured at maximum.

- Therefore it will be assumed that repair budget will be 50 million Sum corresponded to 20% to total budget in 2005 and 150 million Sum need in 2010. But the expenditure of this purpose in 1998 was only 6.1 million Sum.
- If this budget is small, excessive budget will be need in later years because the equipment which can be used longer by proper maintenance must be replaced in shorter time because of lack of proper maintenance. (See Figure8.7.2)

Figure8.7.2 Repair and Improvement Cost for Water Supply System



- Repair and improvement cost shall be decreased of 70 % of necessary budget in 1999 by rearrangement of plants by reduction of distribution volume: the No.3 Intake, the No.6 Intake, No.2 PS and No.4 PS shall be abandoned. And distribution pumps shall be change of these role to transmission pumps therefore they will not be working always.

4) Other

i) Water source

- Chirchik Vodokanal must pay a water resource tax. Therefore according to reduction of intake volume, this tax will be decreased sharply.

ii) Water Pollution by Sewer System

- The raw water of BOD density is relatively high by industrial discharge water therefore BOD removal rate will not be increased.

(3) Improvement of System, Facilities and O&M

1) WTPs

- The automatic operation with the use of sensor and switches should be introduced for pumps.
- The flow meters should be introduced to major distribution pipeline and measured flow rates shall be transmitted, indicated and recorded at control room.
- The water level measuring equipment should be installed at reservoirs and water level and storage volume shall be indicated and recorded at control room, too.
- The pressure gages should be installed at major distribution points in the city but the measured data should not be indicated at WTP because the water pressure will be regulated by gravity distribution.
- An example of these systems is shown in figure 8.7.3.
- The Chirchik Surface WTP must be dosing except for summer season, but the coagulation faciliti-es is not proper for continuous dosing. Therefore, the coagulation facilities shall be improved.

2) PSs

- Two PSs of Chirchik City should be abandoned.

3) Pipelines

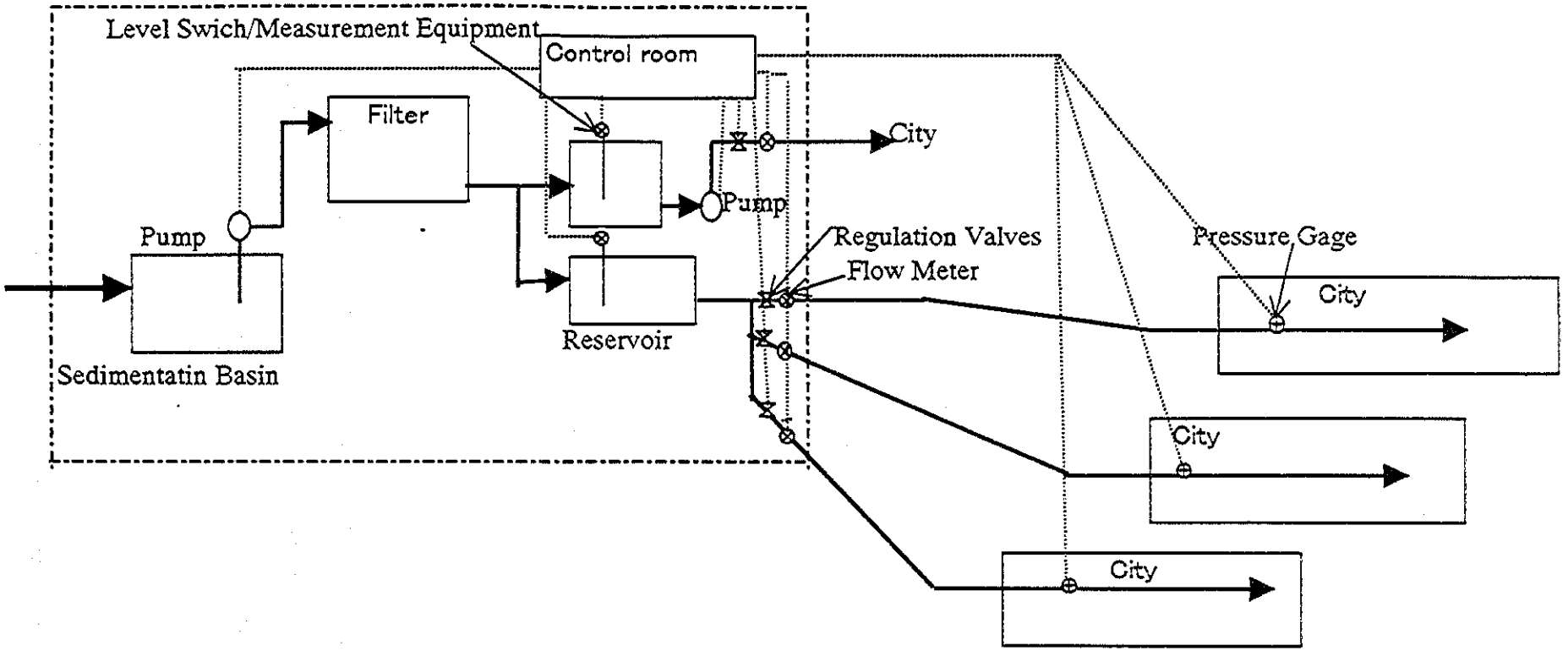
- The old pipes which aged over 42 years and the asbestos cement pipes must be replaced as early as possible.
- The pipelines of Circhik City should be provided with the inner lining therefore replacing pipes shall be used the pipes provided inner lining.
- The pipes of small diameter (less than 150 mm) should use plastic material.
- Pipelines must be renewed at the certain intervals. If the longest interval for replacement in Chirchik City is assumed at 50 years, 5 km (248/50) of pipeline should be replaced annually.
- Therefore, at least 3 to 5 km of pipeline should be replaced every year.

4) Reservoir

- Provision of service reservoir is required to regulate flow fluctuation.

  Retention time needed at service reservoir is assumed at 4 hours in 2,005 and 6 hours in 2010.

Figure 8.7.3 Improvement of Systems for WTPs



In 2005: Maximum daily distribution volume 107,700 cu.m/day x 4/24 =18,000 cu.m

As shown in 4.5.8, the effective volume of reservoir is 10,000 cu.m, therefore needed construction volume will be about 8,000cu.m.

In 2010: Maximum daily distribution volume 88,400 cu.m/day x 6/24 = 22,000 cu.m.

Therefore additional Volume of 4,000 cu.m will be required.

(4) Estimate of the Cost for the Countermeasures

1) Decrease of Leakage

i) Units of Apartment Buildings

- The number of leaking apartment unit is supposed to be 20% of total number of units, and most of leakage point is identified to be toilet.
- An average repair cost of leaking toilet is assumed at 5,000 sum as Tashkent City.

  Total cost: 36,414 units x 0.2 x 5,000 Sum/unit = approximately 36.4 million Sum

  Repair work in five year: 36.4/5 = 7.3 million Sum/year

ii) Detached House

- The number of leaking detached house is supposed at 20% of the total and leakage points are identified at toilet and service pipes in the house. The repair cost of toilet is supposed to be 5,000 Sum/house for 10% of the number of detached house.
- The maximum repair cost of service pipes of house is estimated at about 130,000 Sum/house, thus the average cost is about supposed 50,000 sum for the 10% of the number of detached house.
- Total repair cost: 9,338 houses x (0.1 x 5,000 sum+ 0.1 x 50,000 sum)= 51.4 million sum

  Repair work in five year: 10.3 million Sum /year

iii) Communal Service, Industry and Hot and Heating Water

Repair cost in this category is calculated based on their consumption ratio domestic consumption (consumption of apartment and detached house). Since the industry has already invested considerable amount for leakage repair, the required repair cost is ~ assumed at ~ 50% of the estimated cost.

Communal service: (7.3+10.3) million Sum x 59/496 = 2.1 million Sum/year

Industry: (7.3+10.3) million Sum x 73/496 x 0.5= 1.3 million Sum/year

Hot and heating water: (7.3+10.3) million Sum x 52/496 = 1.8 million Sum/year

iv) Distribution Pipeline

The Materials for leakage repair shall be prepared. For smooth implementation of leakage detection and repair works, replace plan of pipeline shall be decided.

2) Saving Water

i) Campaign

The division for water saving campaign shall be instituted in Vodokanal, and its operation cost is supposed to be about 3 million Sum cooperating with Tashkent Vodokanal.

ii) Meter Installation

The meter installation is the most important action for saving water.

The cost for meter installation will be paid by Vodokanal as calculated below.

For apartment, water meter is installed at inlet part of buildings.

Apartment: 30,000 Sum/apartment building x 660 buildings=19.8 million Sun.

Detached house: 18,000sum/house x 36,400=655.2 million Sum

Total cost =675 million Sum, divided by five years =675/5=135 million Sum/year

3) Improvement of Platns and Facilities

i) WTPs

- Improvement of WTPs and Intake should be conducted the Chirchik WTP and the No.1 Intake.
- Automatic control of pumps: Unit cost --20,000 Dollar/pump

  Chirchik 10units + No.1 Intake 6 units (excepting well pump) --- 16 x 20 = 320 thousands dollar
- Flow meter: 50 thousands dollar/unit (including electric work)

  Chirchik 2 units + No.1 Intake 2 units---2 x 50 = 100 thousand dollar
- Level measurement equipment: Unit cost – 30 thousands dollar/unit (including electric work)

  Chirchik 1 units + No.1 Intake 2 units---3 x 30 = 90 thousands dollar

- Control room: Chirchik--- 1000 thousand dollar, No.1 intake--- 800 thousand dollar
- Coagulation facilities---500 thousand dollar
- Improvement cost--- 500 thousand dollar
- Total cost: 320 + 100 + 90 + 1,000 + 800 + 500 + 500= 3,310 thousands dollar
- Demolition of WTPs: 30 million Sum/WTP

ii) PSs

- No.2 and No4 PS will be abandoned.
- Demolition of PSs: 10 million Sum/WTP

iii) Pipeline

- Average diameter of pipeline is 200 mm in Tashkent City.

  Average replacement cost of 200 mm pipe is estimated at 200 dollar/m=200 thousands dollar /km

iv) Reservoir

- Reservoir with the storage capacity of 8,000 (4000 x 2) cu.m should be constructed by 2005 and an additional 4,000 cu.m reservoir should be constructed by 2010.

  Construction cost is estimated at 220 dollar/cu.m of storage volume.

  4,000 cu.m x 220 dollar/cu.m = 880 thousands Sum / reservoir

- The automatic control of pumping up system shall be installed each reservoir.

  The first and third reservoir: water revel measurement equipment--20 + electric cable 2 km--200 + electric work 80= 300 thousands Sum

  The second reservoir: water revel measurement equipment-- 20 + Auto Valve d-400--30 + signal to WTP (to use telephone line) --100 =150 thousands Sum

- The rearrangement of pipes will have to conduct for Reservoir construction.

  Needed installation of pipes is supposed at 5 km of diameter 400mm (400 thousands dollar/km).

  400 thousand dollar/km x 5km=2,000 thousands dollar

8.8 Summary of the Immediate Solutions

Summary of the solutions to Chirchik Vodokanal is similar to that, presented in 7.8, of Tashkent Vodokanal