6.3 Water Leakage Detection

6.3.1 Outline of Research

(1) Purpose of Water leakage Detection

The basic purposes of water leakage detection are as follows:

i) Ascertain the actual water leakage situation in Chirchik City. Survey the actual leakage condition and the frequency. Estimate the volume of leakage by comparing the water distribution volume and the actual water consumption.

ii) Enlighten the local counterparts to recognize the importance of water leakage detection through on-site activities.

iii) Technology transfer.

(2) Measurement of Distribution Water Volume and Pressure

To ascertain the actual water leakage situation in Chirchik City, the following survey will be conducted:

i) Install self-recording ultrasonic flow meters on the distribution pipes from the WTPs and measure the distribution volume simultaneously over 24 hours.

ii) Install self-recording water pressure meters at the major points of the distribution pipes in the city to monitor fluctuations in water pressure.

(3) Water Leakage Detection

For efficient technology transfer, the following activities shall be carried out:

i) Detect water leakage with a counterpart by the sonic detection method or the relative sonic detection method. Let them recognize the effectiveness of this technique and teach them how to operate the equipment by conducting on-site activities.

ii) Water leakage shall be visually checked at most locations.

The detailed detection process will be described later.

(4) Estimate of Water Leakage Volume

By comparing the results of measurement of the distribution water volume and pressure with the actual water consumption research described in the previous section, the volume of the total water leakage in the city can be estimated.

6.3.2 Measurement of Water Flow and Pressure

(1) Flow Meter Installation

1) Installation Points

The major water sources of Chirchik City consist of the Chirchik surface WTP and No. 1, No. 3 and No. 6 intake facilities. City wells have been omitted due to their low production.

The installation points were determined as follows:

i) As shown in Figure 6.3.1 (1), flow meters were installed on two (2) distribution mains with a diameter of 1,000 mm. Meters were placed in boxes where abandoned electromagnetic velocity meters had been installed.

ii) In the case of the No. 1 intake facility, meters were installed on two (2) exposed distribution pipes with a diameter of 300 mm. Another meter was placed on an incoming pipe of at the No. 4 Pump Station.

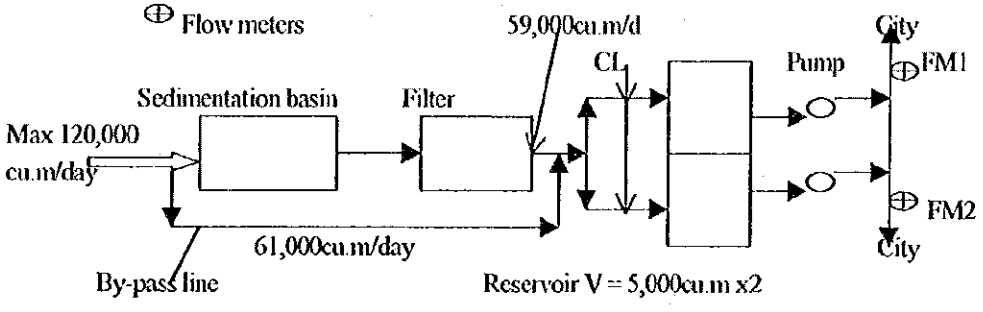


Figure 6.3.1 (1) Flow Meter Installation Points at the Chirchik Surface WTP

iii) As shown in Figure 6.3.1 (3), a meter was installed on the sole distribution pipe with a diameter of 400 mm at the No.3 intake facility.

iv) At the No. 6 intake facility, meters were installed on two (2) distribution pipes with a diameter of 600 mm and 300 mm, respectively.

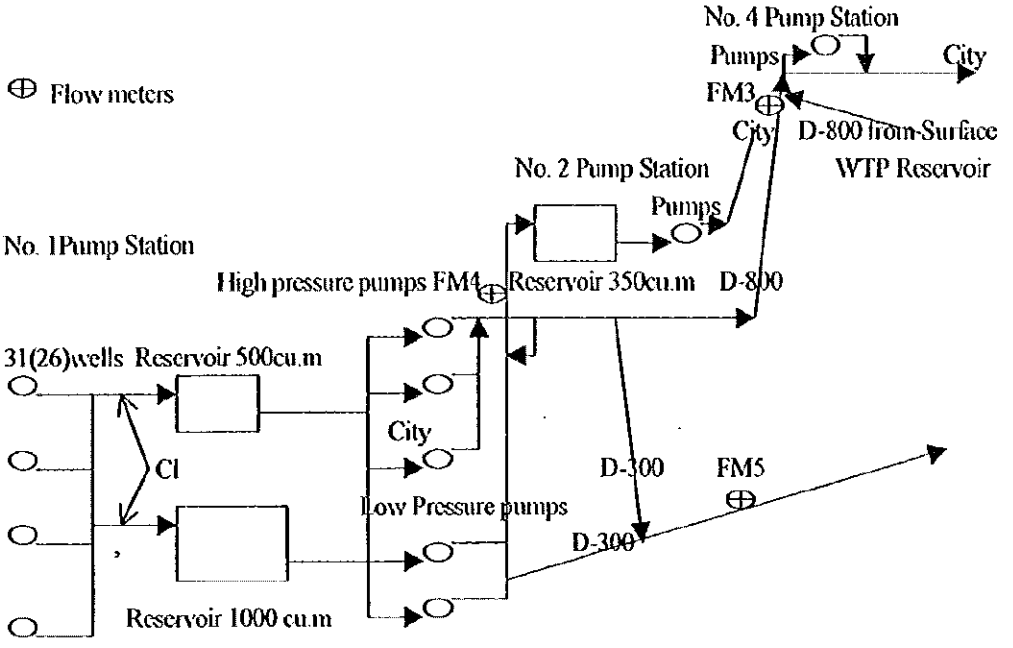


Figure 6.3.1 (2) Flow Meter Installation Points at the No. 1 Intake Facility

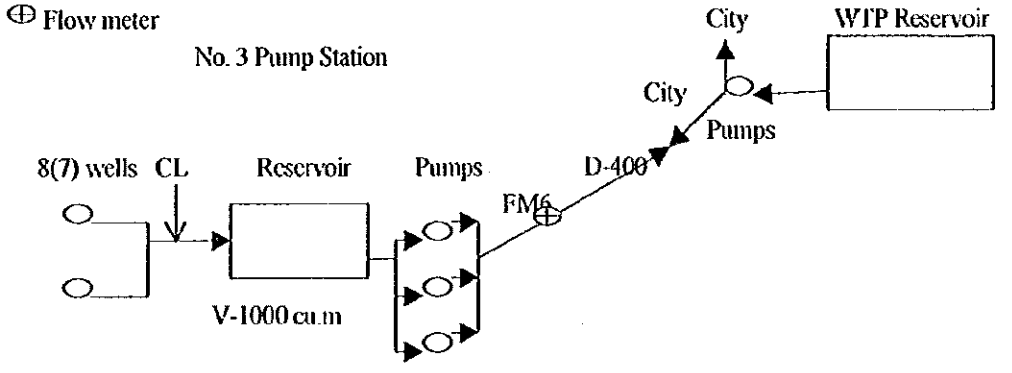


Figure 6.3.1 (3) Flow Meter Installation Points at the No.3 Intake Facility

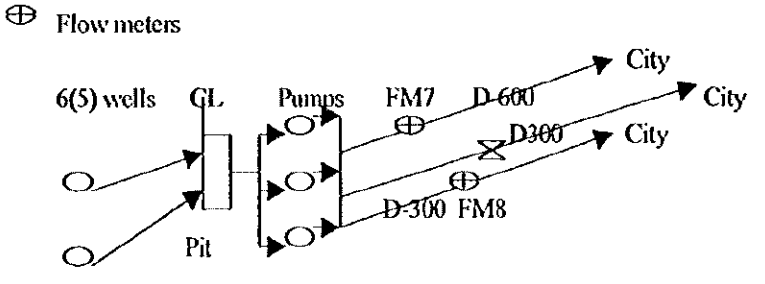


Figure 6.3.1 (4) Flow Meter Installation Points at the No. 6 Intake Facility

The meter installation points are listed in Table 6.3.1.

Table 6.3.1 Meter Installation Points

Name	No.	Diameter (mm)	Installation condition	Date of Installation
Surface WTP	FM1	1,000	In a pit	July.23
	FM2	1,000	In a pit	July.23
No. 1Intake	FM3	800	Excavated hole	July.26
	FM4	300	In a pit	July.22
	FM5	300	In a pit	July.23
No. 3Intake	FM6	400	Excavated hole	July.21
No. 6Intake	FM7	600	In a pit	July.27
	FM8	300	In a pit	July.27

2) Flow Meter

The specifications of the flow meters installed are presented in Table D.5.3.1.

These meters are attachable ultrasonic flow meters which require a certain length of straight pipe for measurement. Moreover, careful adjustment is needed when these meters are installed. However, they also have many advantages such as flexibility of application and their compact design.

Photos 6.3.1 and 6.3.2 show the actual flow meters FM1 and FM3 after installation. Table 6.3.1 presents the meter installation points and dates.

Photo 6.3.1 FM1 Installed

Photo 6.3.2 FM3 Installed

(2) Pressure Gage Installation

1) Installation Points

Pressure gages shall be installed in areas which are prone to low water pressure in water supply network. Pressure measurements shall be taken together with the flow measurement readings. However, since the only available installation points were the pump stations, the meters were installed at the points shown in Figure D.6.3.1, and the location and pipeline of each points are shown Table 6.3.3 Chirchik City Vodokanal also wanted to monitor the pressure fluctuation of the pump stations. The daily pressure fluctuation was minimal. Other 24-hours pressure measurements were carried out disregarding the flow measurement.

Table 6.3.3 Location and Pipeline of Pressure Gages were installed

Mark	Location	Pipe line
P1	In No.4 PS	From No.1PS transmission
P2	In No.4 PS	To City Distribution
P3	Repair shop	Distribution
P4	Pump house	Distribution

2) Pressure Gages

The specifications of installed pressure gages are presented in Table D.5.3.2. A 24-hours recording sheet was used. The meter installation works is shown in Photo 6.3.3.

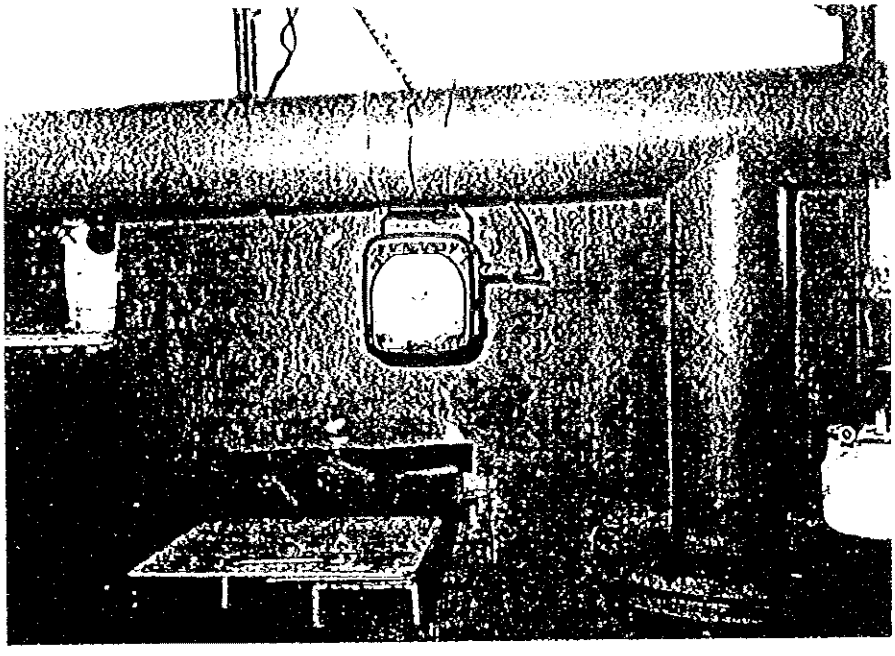


Photo 6.3.3 Pressure Gage Installed

(3) Measured Flow Data

1) Measured Results

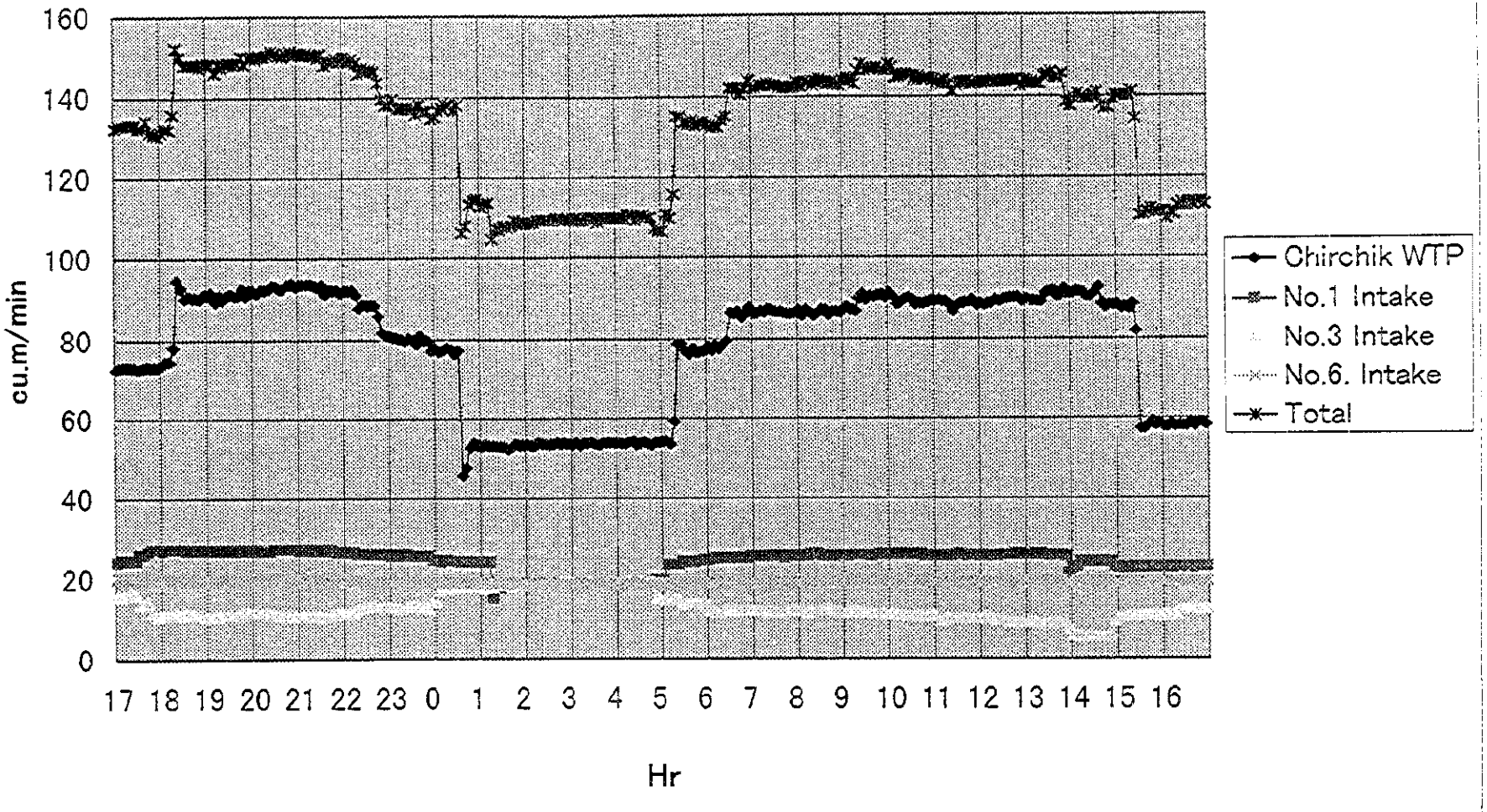
Figure 6.3.2 shows distribution volume of each WTP and Intakes and each distribution volume was shown in Table 6.3.3.

Figure D.6.3.2 presents the flow measurement results of each pipeline at the Chirchik Surface WTP, No. 1 intake, No. 3 intake and the No.6 intake as of 28 and 29 of July 1999. Figure D.6.3.3 shows the total flow in the whole Chirchik City Network System.

Table 6.3.3 Measured Water Volume

Name/Item	Nominal Capacity cu.m/day	Measured Volume cu.m/day
Chirchik WTP	59,000	112,560
No.1 Intake	80,000	34,860
No.3 Intake	20,000	18,220
No.6 Intake	20,000	27,440

Figure 6.3.2 Measured Result of Chirchik Distribution Volume



Based on these results, the total flow of the water supply system was a maximum of 150 cu.m/min = 9,000 cu.m/hr and a minimun of 108 cu.m/min = 6,480cu.m/h. The daily distribution volume was 193,000 cu.m/day. Compared with the total production capacity of the WTPs, 179,000 cu.m/day = 124 cu.m/min = 7,460 cu.m/day, this figure is relatively high.

2) Estimate of Flow Data

Figure 6.3.3 shows the record of operation at each pump station as of of July 28 to 29, 1999.

i) Distribution Lines of the Chirchik Surface WTP

The distribution line on which FM1 was installed supplies water to the city through the No. 4 pump station and the line on which FM2 was fixed is connected to the pipeline coming from the No. 3 Intake.

According to the rated pump capacity, the flow will be 83.4 cu.m/min; however, since the actual water pressure was 4.6 kgf/sq.cm, which is lower than the rated pressure of 6 kgf/sq.cm, the flow might be greater.

According to the measurement results, the total flow measured at FM1 and FM2 from 17:00 to 18:00 was 75 cu.m/min, from 18:00 to 22:00 it was 90 cu.m/min, from 22:00 to 24:00 it was 80 cu.m/min, from 0:00 to 5:00 it was 54 cu.m/min. Based on the specifications of the pumps, these figures are reasonable taking into account the rated pump capacity and the hydraulic heads.

The actual distribution record of the Surface WTP, 90 cu.m/min = 129,000 cu.m/day with 10 hours of continuation was enabled by supplying raw water to the reservoirs by bypassing the water treatment.

ii) Distribution Lines of the No. 1 Intake (Pump Station)

Flow measurement results show that the total flow in the distribution pipes of the No. 1 Intake from 17:00 to 24:00 was 28.0 cu.m/min, which is higher than the rated pump capacity of 23.3 cu.m/min. This is because of the low pressure in two of the three distribution pipes, on which FM3 to FM5 were installed. The pressure was 9.5 and 7.5kgf/sq.cm, respectively.

When one distribution pump at the Surface WTP was stopped and the water pressure fell, the flow measured at FM3 increased significantly from 11～12 cu.m/min up to 18～19 cu.m/min. This is also because of the low pressure within the system. In this case, the distribution volume of the No. 1 intake was 32 cu.m/min as ppposed to the rated pump capacity of 20.8 cu.m/min.

Figure 6.3.3 Working Record of Pumps

Name	P.No. or	Capacity	28th							29th																	
			17	18	19	20	21	22	23	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Surface WTP	1	20.8																									
	2	20.8																									
	3	41.7																									
	4	41.7																									
	Total		83.4							41.7			62.5		83.4										62.5	41.7	
	Pressure kgf/sq.cm		4.6	4.6	4.6	4.6	4.6	4.6	4.6	1.8	1.9	2	3.2	3.2	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	3	3.4	
No.1PS	1	20.8																									
	2	3.3																									
	Total		23.3							20.8															23.3		
	Pressure1 kgf/sq.cm		11.8	11.8	11.8	11.8	11.8	11.8	11.8	9	9	9.5	9.5	9.5	10	11.5	11	10	9.5	9	8.5	8.5	8	8	8.5	8.5	
	Pressure2 kgf/sq.cm		9.5	9.5	9.5	9.5	9.5	9.5	9.5	8	8	8	8.5	9	9.5	9.5	9	9	8.5	8.5	8	8	7.5	7.5	7	7	
	Pressure3 kgf/sq.cm		7.5	7.5	7.5	7.5	7.5	7.5	7.5	6	6	6.5	6.5	7	7	7	7	7	7	7.5	7.5	7	6.5	6	6	5.5	5.5	
No.3PS	1	8.3																									
	2	3																									
	Total		8.3							3					8.3												
	Pressure kgf/sq.cm		5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	4	4	4	4	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	
No.6PS	1	8.3																									
	2	8.3																									
	3	8.3																									
	Total		24.9																								
	Pressure kgf/sq.cm		8.4	8.4	8.4	8.5	8.5	8.5	8.5	8.6	8.6	8.6	8.6	8.6	8.5	8.5	8.4	8.4	8.4	8.5	8.5	8.5	8.5	8.6	8.6	8.6	

Pump working

iii) Distribution Line of the No. 3 Intake (Pump Station)

Distribution volume of the No. 3 intake during 17:00 to 24:00 was 9.5 cu.m/min, against the rated capacity of the pump, which is 8.3cu.m/min. This is attributable to the low pump head of 5.4 kgf/sq.cm as the rated pump head is 9.5cu.m/min. During the night after 1:00 a.m, only pumps with a small capacity of 3.5 cu.m/min are operated.

The reason for this operational arrangement is to recover the lowered water level during the night for the daytime operation of pumps with a larger capacity.

iv) Distribution Line of the No. 6 Intake (Pump Station)

Pumps of the No. 6 Intake operate continuously over 24 hours but the actual pump distribution volume was 18 to 19 cu.m/min, smaller than their rated capacity of 24.9 u.m/min. This is because the overloaded pumping operations were overloaded by the pump head of 8.5 kgf/sq.cm against the rated pump head of 7.0 kgf/sq.cm.

v) Total Distribution Volume in Chirchik City

Figure 6.3.4 shows the distribution volume balance of the entire Chirchik City System. As shown in the figure, a large percentage of the total water consumption was consumed in Districts A and E and the total consumption is 106,000 cu.m/day during the day, but only 67,000 cu.m/day during the night. Water consumption in other districts is summerized as follows:

Zone	Day Consumption	Night Consumption
B, B-1	13,000 cu.m/day	11,000 cu.m/day
C	40,000 cu.m/day	27,000 cu.m/day
D	29,000 cu.m/day	29,000 cu.m/day

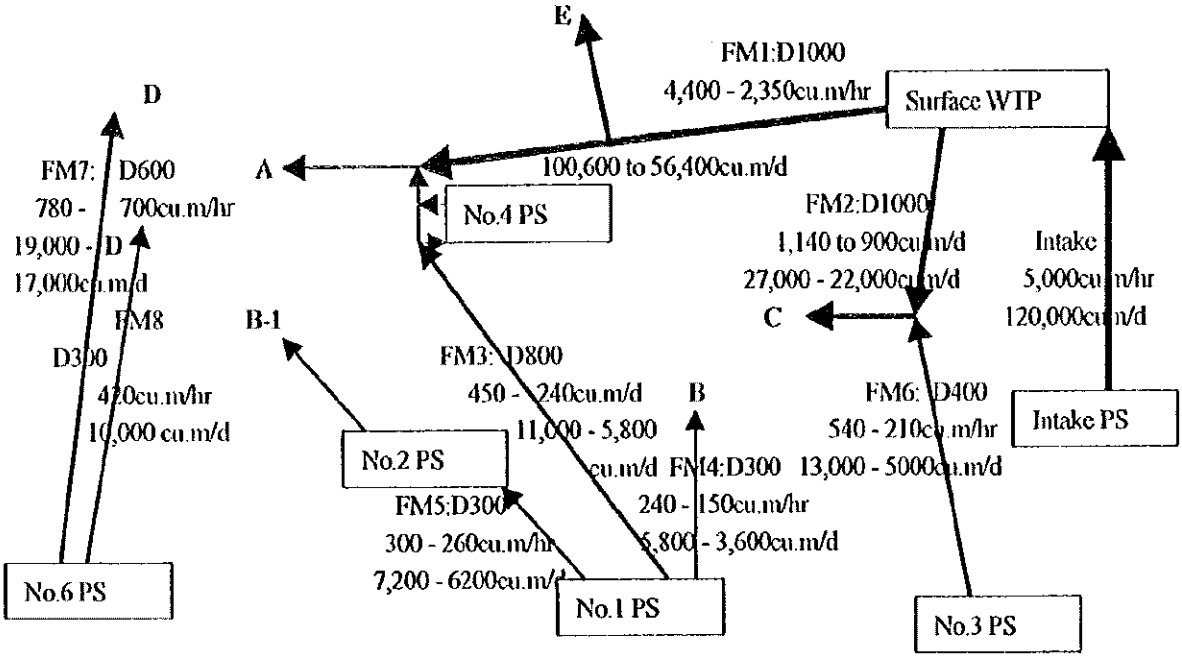


Figure 6.3.4 Water Distribution Balance in Chirchik City

(4) Measured Pressure Data

Figure 6.3.5 presents the results of the water pressure survey in Chirchik City.

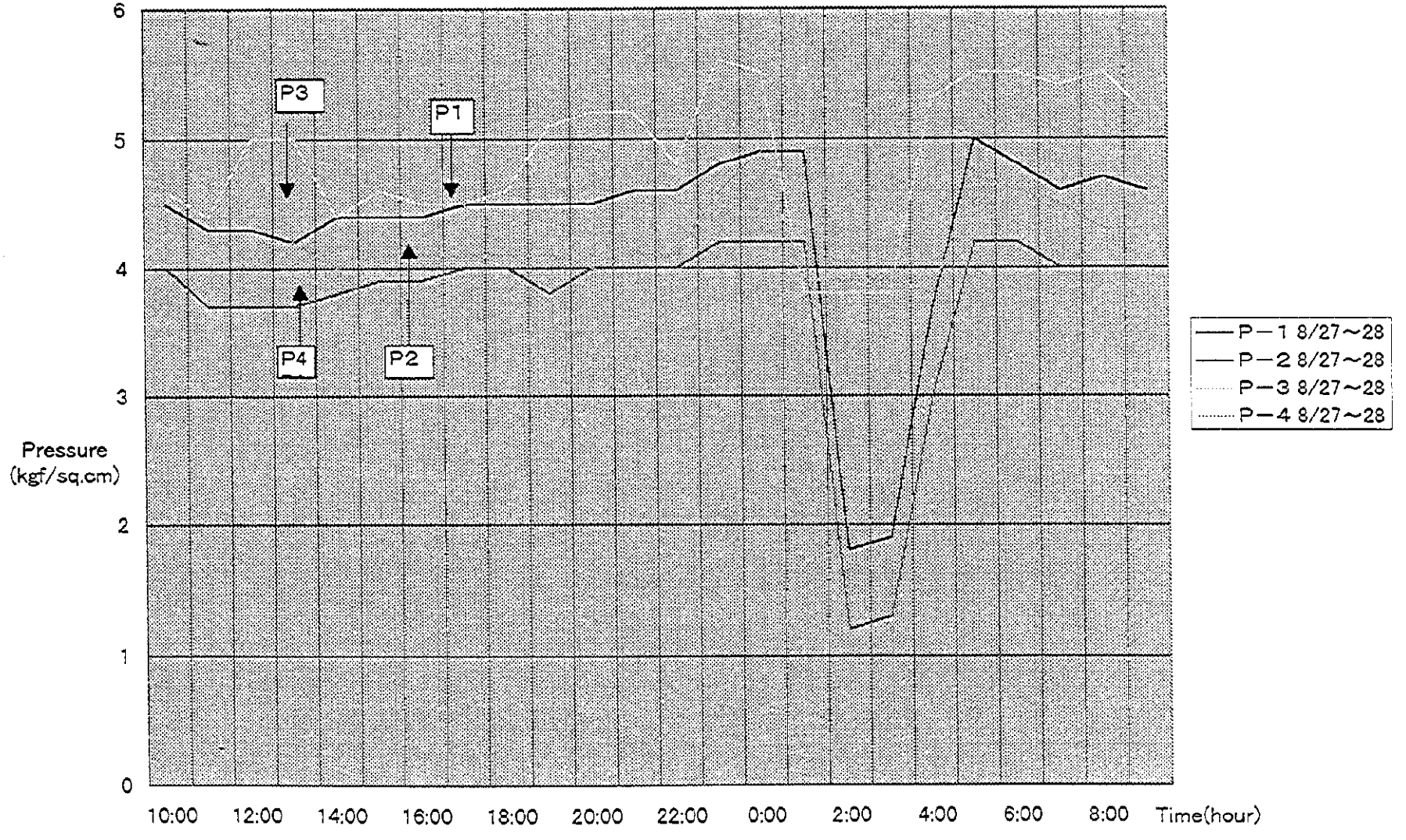
The pressure in the force main coming from The No. 1 pump station towards the No. 4 pump station, P1 is high and mostly exceeds 4.5 kgf/sq.cm, while pressure in the distribution pipe from the No. 4 pump station, P2 is below 4 kgf/sq.cm, 0.5 kgf/sq.cm lower. Both P1 and P2 declines during the nighttime when number of pumps in operation decreases.

This decline in pressure is also attributable to the small diameter of the force main from the No. 1 pump station (800 mm) and of the distribution pipe from the No. 4 pump station (300 mm).

The pressure at the workshop located downstream of the Surface WTP (P3) is the highest and usually exceeds 5 kgf/sq.cm with a minimum pressure of 4 kgf/sq.cm. Pressure at the booster pump station serving the 12-story apartment building in a higher area of the city (P4) also exceeds 4 kgf/sq.cm; however, the pressure falls sharply during the night.

Although located in higher areas, the four (4) points mentioned above have high pressure, 4 kgf/sq.cm, except for during the night. This situation is advantageous for the water supply for high buildings, but is less economical in terms of power consumption since all treated water is supplied by pumping.

Figure 6.3.5 Water Pressure in Chirchik



6.3.3 Water Leakage Detection

(1) Selection of Water Leakage Detection Methods

1) Detection Equipment

For this study, these three (3) detection methods were selected;

- Sonic detection method (noise detection, general method but a high level detection skill will is required)
- Relative sonic detection method (noise detection, noise will be detected at two points and the distance to the leakage points will be calculated based on the time lag of the noise transmission at the two points)
- The minimal flow method (water consumption will be minimum during the night). To detect the leakage point(s) and the volume, the flow will be measured at the target distribution main closing valves of the connections in the detached houses.

Therefore sonic detection equipment, relative sonic detection equipment and ultrasonic flow meters (used for measuring flow of entire city) were prepared.

2) Detection Methods

i) Sonic detection method

This method of detection is used mainly on the main distribution pipes and is important because the volume of leakage reported from pipes installed in the roads amount to more than 80% of the entire volume of leakage in Japan. This detection is relatively difficult since the detector cannot distinguish leakage noise from other noises. Skill and experience will be needed.

The detector walks along the distribution pipes and uses the noise detector on the Surface of the Road(See Photo-4). This detection should be conducted around midnight (between P.M.12:00 and A.M 5:00), because various general noises and the water flow will be minimal late at night.

ii) Relative Sonic Detection Method

In this method, noise will be detected in two points and distance to the leakage point will be calculated by the time rag of noise transmission in two points.

Photo.4 Sonic Detection on Road Surface

After measuring the distance between the target 2 valves the sensors will be attached 2 valves to find the relative wave pattern. If relative wave pattern is found, distance from leaking point will be calculated by propagation velocity and distance of two valves.(See photo.5)

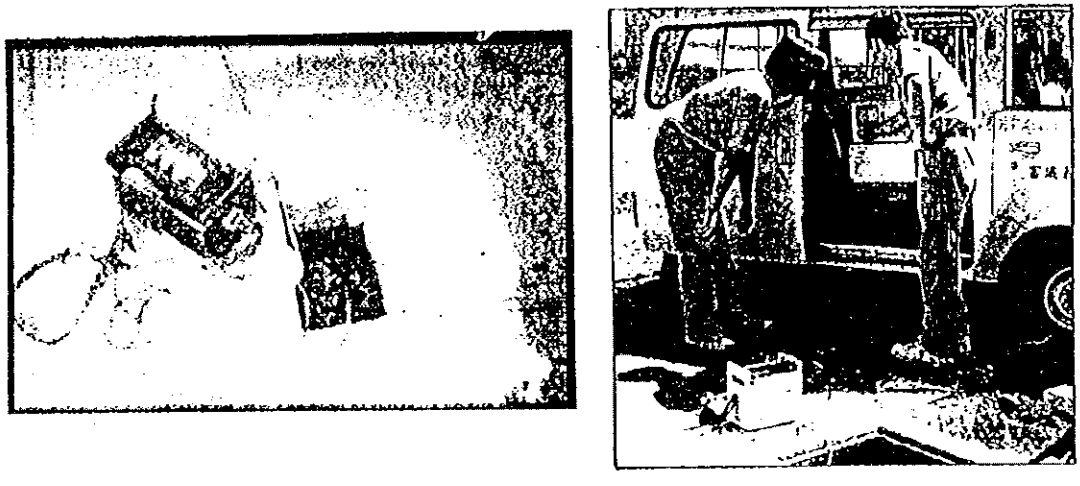


Photo. 5 Relative Sonic Detection

iii) Minimal Flow Method

Although aforementioned detection method can find the leakage point, can't measure leakage volume. Therefore, applying minimal flow method is necessary.

In this method the water flow will be measured at the target pipeline section during midnight. Mesured volume will be mainly leakage because water consumption will be minimum for that time.

One or two self-recording ultra sonic flow meter will be attached to pipe after closing all valves down-stream.

3) Selection of Water Leakage Detection Equipment

Although the necessary detection equipment for the aforementioned three (3) detection methods were prepared, based on the site conditions it was determined that the sonic detection method was the most applicable and that the relative sonic detection method was partially applicable and minimal flow method was not applicable. The reasons are as follows:

- Due to in-house water leakage and institutional use, for example water use in parks where the water flow does not stop even at night. The minimal flow method operates on the premise that little water flows during the night and thus is not applicable.
- The relative sonic detection method is applied specific leakage points. Accoirdingly, the target leakage area must be located by the sonic detection method in advance. When the detailed leakage must be specified, this method is applied.

According to Chirchik City Vodokanal, water leakage is easily found since the ground is adhesive and has slopes, and thus leaked water spurts out of the ground. Based on the discussion with Vodokanal staff, there is little need for water leakage detection.

(2) Water Leakage Detection in Chirchik City

1) Selection Target Area

Chirchik City Vodokanal selected the target areas for water leakage detection. The areas were selected from the viewpoint of low interference with traffic and possibility of water leakage. The target areas are shown in Figure D.6.3.1.

Most of the northern where the distribution main with a diameter of 1,000 mm × 15 km is located, is partially -developed wilderness. The installation depth ranges from 1 m to 4 m. The city road along the distribution main with a diameter of 800 mm × 5 km is surrounded by apartment buildings and open lots and thus this area has less traffic.

2) Results of Detection

Water leakage detection was conducted in the daytime starting from 23 to 27 of August 1999.

In the northern area, sonic detection was conducted for all the detection surveys and three leakage ponts were found but there were leaking water spouts on the ground. Therefore leakage detection was actually not needed. Similar sounds were detected in city roads but these were the flowing sounds of sewage. No leakage was found.

Mr. Alferjev, Director of the Production Technology Department of the Chirchic Vodokanal attended all water leakage detection sessions and pointed out the correct locations of the pipes. Technical transfer to the counterpart was executed on site using sonic detection equipment. Photos 6.3.6 and 6.3.7 show the actual detection and technical transfer activities.

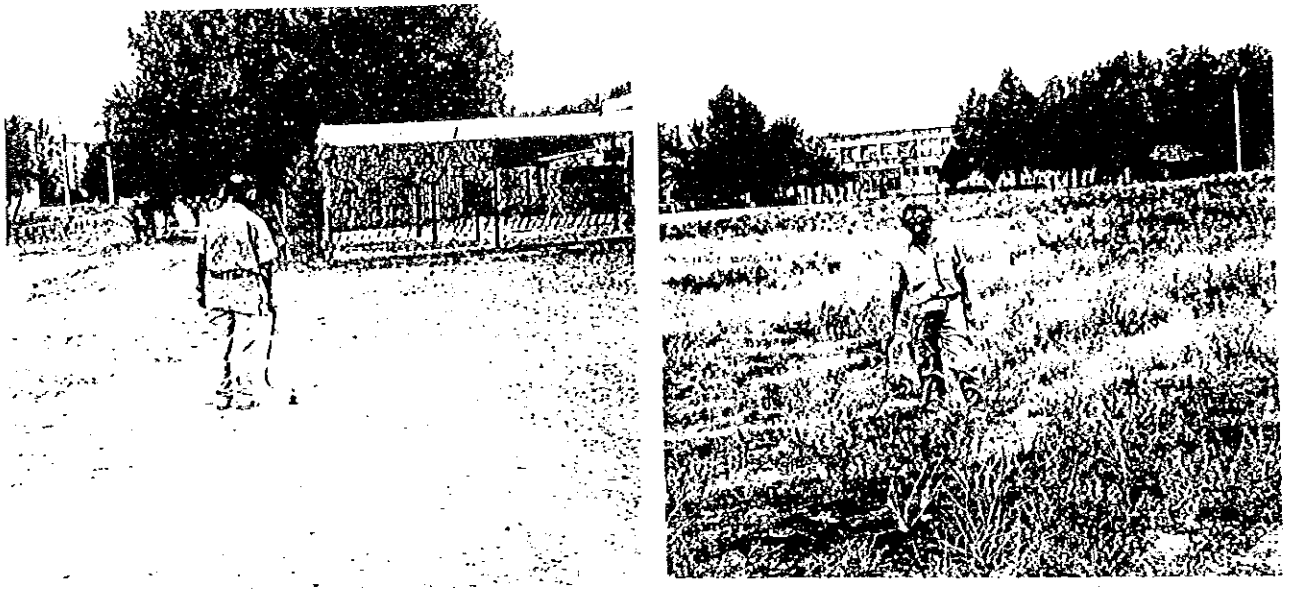


Photo 6.3.6 Conducting Sonic Detection

Photo 6.3.7 Technical Transfer of Sonic Detection

6.3.4 Estimate of Water Leakage Volume and Rate

(1) Calculation of Water Flow Balance and Unknown Water Volume

1) Condition of Calculation

In accordance with the results of supply survey, the consumption of apartments exceeds 600 L/capita/day in August and about 500 L/capita/day in September. As for detached houses, it is more than 600 L/capita/day in August and September as high consumption period, and about 500 L/capita/day in November. Table 6.3.4 shows the analysis of water consumption in Chirchik City.

The analysis has been made on the following assumptions:

i) The population of Chirchil City maintains same level these past years, so it adopts 146,000 for the supply population in Chirchik City.

ii) In case of Chirchik City, it is not possible to estimate unknown water rate from the inflow volume into sewerage plants, since inflow volume of sewerage plants is more than the one of distribution volume of supply water (significant volume of inflow of ground water into sewer.)

iii)whole city distribution, communal service of large consumption volume, industry use and individual and large consumption volumes of hot water and heating system (in accordance with the Chirchik City Vodokanal data) are shown in the columns of a), c), h), I) and j) of Table 5.3.6.

iv) Individual consumption should be basically adjusted to make the unknown water rates about same by using the measured data of water consumption.

In Chirchik City, individual norma water volume including hot and heating water volumes is 400 L/capita/day.

2) Evaluation of Calculation Result

The unknown water rate is 12.5 % in comparison with the distribution volume and consumption volume on the assumption that individual water consumption to be 650 L/capita/day in August and 550 L/capita/day in September, based upon the figures of the survey. This volume responds to the unknown water rate of distribution pipeline including the volume of irrigation in parks.

Based upon the above, allocating the individual consumption of 450-650 L/capita/day to each month, summer consumption is rather big and less in other seasons, and the annual average consumption comes to be 496 L/capita/day. The balance of these figures is shown in Figure 6.3.6.

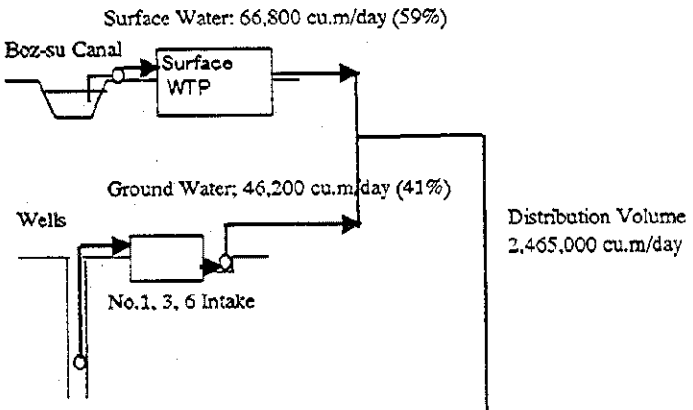
Table 6.3.4 Analysis of Water Consumption and Unknown Water in Chirchik City

Mark			a	b	c	d	e	f	g	h	I	j	k
Expression						b+c		e*146.000		g*146.000	k+m	a-n	o/a*100
Item			Distribution Volume	Large Water Consumption			Water Consumption of Individual				Total Consumption	Unknown Water: leakage & Irrigation	Unknown Water Rate
			Total	Communal service*1	Industry	Total	Cold Water		Hot Water				
Units			cu.m/m. cu.m/d	cu.m/m. cu.m/d	cu.m/m. cu.m/d	cu.m/m. cu.m/d	cu.m/m. cu.m/d	cu.m/m. cu.m/d	cu.m/m. cu.m/d	cu.m/m. cu.m/d	cu.m/m. cu.m/d	cu.m/m. cu.m/d	%
1999	May	/month	3,200,000	283,656	281,634	565,290	14	2,036,700	1,240	181,040	2,783,030	416,970	
		/day	103,226	9,150	9,085	18,235	0.45	65,700	0.040	5,840	89,775	13,451	13.0
	Apl.	/month	3,430,000	264,493	479,249	743,742	14	1,971,000	1,350	197,100	2,911,842	518,158	
		/day	114,333	8,816	15,975	24,791	0.45	65,700	0.045	6,570	97,061	17,272	15.1
	Mar.	/month	3,400,000	253,800	383,809	637,609	14	2,036,700	2,480	362,080	3,036,389	363,611	
		/day	109,677	8,187	12,381	20,568	0.45	65,700	0.080	11,680	97,948	11,729	10.7
	Feb.	/month	3,450,000	259,047	394,142	653,189	14	2,044,000	2,520	367,920	3,065,109	384,891	
		/day	123,214	9,252	14,077	23,328	0.50	73,000	0.090	13,140	109,468	13,746	11.2
	Jan.	/month	3,650,000	265,567	419,493	685,060	14	2,036,700	3,100	452,600	3,174,360	475,640	
		/day	117,742	8,567	13,532	22,099	0.45	65,700	0.100	14,600	102,399	15,343	13.0
1998	Dec.	/month	3,240,000	267,533	315,354	582,887	14	2,036,700	1,643	239,878	2,859,465	380,535	
		/day	104,516	8,630	10,173	18,803	0.45	65,700	0.053	7,738	92,241	12,275	11.7
	Nov.	/month	3,140,000	268,510	255,396	523,906	14	1,971,000	1,500	219,000	2,713,906	426,094	
		/day	104,667	8,950	8,513	17,464	0.45	65,700	0.050	7,300	90,464	14,203	13.6
	Oct.	/month	3,040,000	284,578	223,745	508,323	14	2,036,700	1,240	181,040	2,726,063	313,937	
		/day	98,065	9,180	7,218	16,398	0.45	65,700	0.040	5,840	87,938	10,127	10.3
	Sep.	/month	3,650,000	287,536	270,104	557,640	17	2,409,000	1,200	175,200	3,141,840	508,160	
		/day	121,667	9,585	9,003	18,588	0.55	80,300	0.040	5,840	104,728	16,939	13.9
	Aug.	/month	4,170,000	230,196	312,458	542,654	20	2,941,900	0.905	132,159	3,616,713	553,287	
		/day	134,516	7,426	10,079	17,505	0.65	94,900	0.029	4,263	116,668	17,848	13.3
	July	/month	3,940,000	222,841	313,520	536,361	19	2,715,600	0.930	135,780	3,387,741	552,259	
		/day	127,097	7,188	10,114	17,302	0.60	87,600	0.030	4,380	109,282	17,815	14.0
	June	/month	3,100,000	263,001	228,821	491,822	15	2,190,000	0.900	131,400	2,813,222	286,778	
		/day	103,333	8,767	7,627	16,394	0.50	73,000	0.030	4,380	93,774	9,559	9.3
Annual Total		cu.m	41,410,000	3,150,758	3,877,725	7,028,483	181	26,426,000	19,008	2,775,197	36,229,680	5,180,320	12.5
Average		cu.m/d	113,452	8,632	10,624	19,256	0.496	72,400	0.052	7,603	99,259	14,193	12.5

Item	Number	Occupant:Ave.	Occupant Total	Rate(%)
House	9,338	3.7	34,551	25.7
Apartment	36,414	2.75	100,139	74.3
Communal	184			
Industry	403			
Total			134,689	

Figure 6.3.6 Water Volume Balance of Chirchik City

Annual average volume



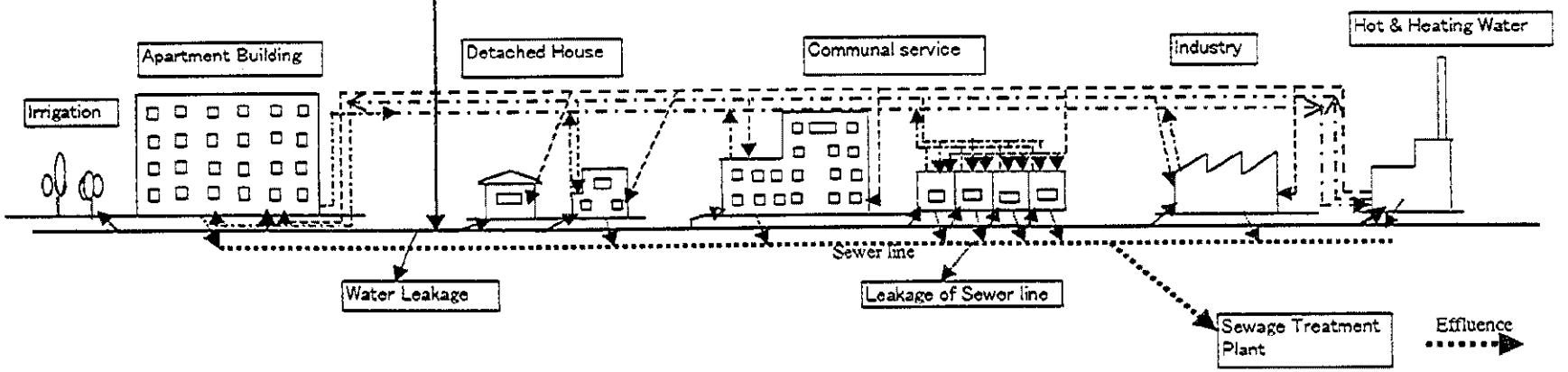
Distribution Volume
2,465,000 cu.m/day

Possibile Water Reduction

Item	Apartment Building	Detached House	Communal Service	Industry	Hot & heat	Total
Distribution Volume(L/capita/day)	496	496	59	66	53	--
Real Consumption(L/capita/day)	230	300	35	46	48	--
Waste or Leakage(L/capita/day)	266	196	24	20	5	--
Possible Reduction(10^6cu.m/year)	10.53	2.68	1.28	1.07	0.27	15.83

Flow Balance of Water Supply

Classification	Apartment Buildings	Detached Houses	Communal Service	Industry	Hot & Heating-water	Unknown: water Leakage &	Total
House Number	36,414	9,338	—	—	—	—	45,752
Population	108,500	37,500	—	—	—	—	146,000
Consumption(m^3/day)	53,816	18,600	8,632	10,624	7,603	14,200	113,475
Comsumption Rate(%)	47.4	16.4	7.6	9.4	6.7	12.5	100.0
Criteria(L/capita/day)	496	496	59	73	52	97	777
Annual Total(10^5cu.m)	19.64	6.79	3.15	3.88	2.78	5.18	41.42



(2) Evaluation of Water Leakage Volume and Rate

In accordance with the survey data of supply water, it exceeds 500 L/capita/day in apartment, more than 600 L/capita/day in individual houses in summer and 500 L/capita/day in November.

But real water consumption per capita in Chirchik City that is calculated in S.6.2.1 is estimated 300L/capita/day as the maximum and 240L/capita/day as the average.

This difference is brought from the leakage in house like in Tashkent. In case of large consumption, the leakage is rather small (in Tashkent, large consumption is about 30 % and 17 % in Chirchik) in comparison with individual consumption. Because of this the prevention of leakage and wasting seems to be well controlled comparatively and assumed the leakage of 40 % in communal service and 20 % in industry. As for hot water and heating system, as decided by Chirchik, Vodokanal, 80.9 % is allocated to individual and 19.3 % to large consumption. Individual consumption of hot water and heating system adopted 52 L/capita/day which is small comparing with 127 L/capita/day in Tashkent and 20 % of leakage based upon the report that the leakage of hot water is big.

The estimation of leakage, based upon the above, is mentioned in Table 6.3.5.

As explained in the table, in Chirchik, the leakage is about 50 %, including the one of building inside. The leakage of distribution pipeline on road is rather small but the volume itself is big comparing with the one in Japan. As for individual consumption, supposing that the volume over the water consumption in Japan is wasting, it can be reduced to the one of the Japanese standard.

Reduction volume of wasting shall be small in Chirchik case.

Table6.3.5 Assumption of Water Leakage and Waste in Chirchik City

Population: 146,000

Item	Units	Individual Consumption			Large Consumption			Water Leakage of Pipeline	Total	Rate(%)
		Apartment	Detached house	Hot/heating Water	Communal service	Industry	Hot/heating Water			
Population	%	74.3	25.7							
Hot/heating Water Rate	%			20.1			80.9			
Distribution Volume	L/capita/d	**496**	**496**	**52**	**59**	**60**	**13**	**97**	**777**	**100.0**
	cu.m/day	53,805	18,611	7,592	8,614	8,760	1,898	14,162	113,442	
	L/capita/d	**548**			**132**			97	777	
	%	70.5			17.0			12.5	100.0	
Real Water consumption	L/capita/d	**230**	**300**	**40**	**35**	**48**	**10**	**0**	**380**	**48.9**
(Including Waste Water)	cu.m/day	24,950	11,257	5,840	5,110	7,008	1,460	0	55,625	
	L/capita/d	287			93			0	380	
	%	**75.5**			**24.5**			**0.0**	**100.0**	
Water Leakage Volume	L/capita/d	266	196	12	24	12	3	97	380	
	cu.m/day	28,855	7,354	1,752	3,504	1,752	438	14,162	57,817	
	L/capita/d	**261**			**39**			**97**	**397**	**51.1**
	%	**65.7**			**9.8**			**24.4**	**100.0**	
Water Waste Volume	L/capita/d	9			---			0	9	1.2
To Japan Level	cu.m/day	1,600						0	1,600	
	%	100.0			0.0				100.0	
Possible Deduction	L/capita/d	270			39			77	386	49.7
Volume (Water reakage in	cu.m/day	39,420			5,694			11,242	56,356	
Housings)	%	69.9			10.1			19.9	100.0	
Water Consumption in Japan	L/capita/d	278			93			20	391	
	%	**71.1**			**23.8**			5.1	**100.0**	

6.4 Analysis of Field Survey

6.4.1 Summary of Questionnaire Survey

We conducted questionnaire surveys in August and November 1999. The objective of the questionnaire surveys is to evaluate the resident users' awareness or the corporate users' awareness in Chirchik regarding the following key issues.

(1) Water conservation

(2) User participation

(3) Willingness and Ability to pay the present water tariff systems and the future tariff system on the future improvement program

(4) Water Leakage

(5) Need for the possible improvement in the service areas

We summarize conclusions of the key issues of the survey as follows.

(1) Awareness on Water Conservation

1) Resident Users

Resident users' awareness on water conservation is evaluated to be at an adequate level that they may understand the need of water conservation, and that they will take practical actions for reducing the expense, even in the case of implementation of new water tariff collection system by meter reading.

We also evaluate resident users' awareness on environmental issues is quite normal on this point.

2) Corporate Users

Corporate users, as a whole, have understood the need of water conservation and are much concerned about water conservation. Their awareness on water conservation is

higher than that of individual users' because they need keener sense of water cost for better management under the tariff collection system with meter reading.

(2) Awareness on User Participation

1) Resident Users

Resident users have positive awareness and much concern about the public interest issues including the cost of water tariff or the management performance of Vodokanal from the users' point of view. In addition to this point, the lack of good communication with Vodokanal may make users willing to communicate with the Vodokanal. Therefore, their awareness and willingness for user participation is evaluated to be positive.

2) Corporate Users

The corporate users also have the positive awareness on much more concern about the cost of water tariff or the management performance of Vodokanal from the management's point of view. In addition to this point, the lack of well communication with Vodokanal may make users willing to communicate with the Vodokanal. Therefore their awareness on willingness to the user participation is evaluated to be positive.

(3) Awareness on Willingness and Affordability to Pay the Present Water Tariff

1) Resident Users

65% resident users' awareness on the affordability to pay the water tariff is evaluated to be negative. 47% or 18%, respectively, answered that the present tariff is expensive or that it is hard to pay. The users show, in addition, their discontent with Vodokanal service, such as the quality of water and the water interruption. It is pointed out, therefore, that to raise the water tariff unreasonably will presumably increase the antipathy of even the individual user living in an apartment.

2) Corporate Users

Corporate users' awareness, as a whole, on the affordability to pay the water tariff is evaluated to be at a level to accept, to some degree, the increase of water tariff. It is pointed out, however, that to raise the water tariff unreasonably will presumably increase the antipathy of even corporate users in the manufacturing industry. 80% manufacturing industry show that the present tariff is expensive under the tariff system by meter reading.

(4) Awareness on Willingness and Affordability to Pay the Future Water Tariff

1) Resident Users

81% individual users consider that it is a fair tariff concept and that water tariff should be calculated and charged based on consumed volume of water. More than half (63%) interviewed resident users agree to a tariff system to pay for the water tariff according to their actual consumed volume of water by reading meter. It turned out that most opponents of the system need a safety net for the poor and the pensioner on the system.

79% of interviewed individual users prefer to pay for the installation cost of the meter divided into the monthly tariff. 15% of interviewed people would like to pay for meter installation at once after installation. 6% of people prefer other ways.

2) Corporate Users

Results show that most corporate users understand and support the current tariff system based on actual consumption by reading meter. 68% corporate users consider that it is a fair tariff concept and that water tariff should be calculated and charged based on consumed volume of water. 62% corporate users agree to a tariff system to pay for the water tariff according to their actual consumed volume of water by reading meter.

53% of interviewed companies would like to pay for the installation cost of the meter divided into the monthly tariff. 44% of interviewed companies would like to pay for the meter installation cost at once. 3% of companies prefer other ways.

(5) Awareness on Water Leakage

1) Resident Users

Their awareness on water leakage is evaluated to be a highly potential issue for the resident users after the implementation of the water tariff collection system charged by meter reading. 41% of the individual users answered that they had noticed water leakage from water distribution pipes inside their house. In general, 71% of them are discontent with the repair service for water leakage. 55% of interviewed resident users feel improvement of the quality of the repairers' services is most important. It is noted that for the apartment resident users only 16.2% of the apartment resident users are content with the services of JEK.

2) Corporate Users

22% of interviewed corporate users answered that they had noticed water leakage from water distribution pipes inside their companies. However, it is found that the corporate users have much concern about the water leakage. 55% of interviewed companies need more improvement in the quality of the repairing service for the water leakage. In addition, 13% corporate users show that they need information provided by the Vodokanal to prevent the water leakage.

(6) Areas to Improve on Vodokanal in Near Future

1) Resident Users

The highest priority area to improve from the users' point of view is the issue of safety of water quality for health reasons. 50% of interviewed users chose the item of safety of water quality for health. The next priority area to improve is the issue of stability of water supply. It includes water interruption and low pressure of water issues. 32% chose the item of stability of water supply. The third priority area to improve is the current water tariff including the price. 16% wish to decrease or improve the current water tariff. 1% of

people accordingly answered that they would like to have a better tariff collection system. 1% need more communication with Vodokanal.

2) Corporate Users

The highest priority area to improve from the users' point of views is the issue of safety of water quality for health. 46% of interviewed companies wish to improve water quality. The next priority area to improve is the issue of stability of water supply. 31% of them would like to have more stable water supply. It includes the water interruption and low pressure of water issues. The third priority area to improve is the current water tariff including the price. 16% of companies wish to decrease or improve tariff system. 3% and 3% of interviewed companies answered, respectively, that they prefer to have more communication with Vodokanal and better tariff collection system. 1% companies chose other items.

CHAPTER 7

PROPOSED SOLUTIONS FOR TASHKENT CITY VODOKANAL

Chapter 7 Proposed Solutions for Tashkent City Vodokanal

This chapter refers to the proposed solutions to the issues in water supply services in Tashkent City stated in chapter 3. Firstly, the awareness of the issues and basic elements of solutions are discussed in 7.1. The detailed solutions are stated according to certain factors; finance and management in 7.2, tariff collection in 7.3, tariff table in 7.4, introduction of a computer system in 7.5, public participation in 7.6, and maintenance and operation in 7.7. A summary of the solutions is finally identified according the level of importance in chapter 7.8.

7.1 Overview of Proposed Solutions

7.1.1 Issues on Water Supply Services in Tashkent City

The current issues of water supply services in Tashkent City are roughly summarized as below.

(1) A project of installation of water meters at public users' sites has not proceeded as planned, and the users in general public are charged water bills based on fixed rate system. Also, there is a large gap in charges between the general public and corporations.

(2) As the result, large extent of precious water resources have been wasted and Vodokanal has spent on the costs of wasted water treatment and supply.

(3) A lag in water tariff policy creates that the financial foundation becomes weak because sufficient water charges can not be collected to offset these wasted costs and the facilities and equipment are not adequately maintained as required.

7.1.2. Step-by-Step Approach

The Study Team set up three stages so that each stage has an aim to be targeted in order to draft solutions to the above issues.

(1) The First Stage - Provision of requirements for a self-supporting system

The targets for the 1st stage are :

1) To change the collection system from a fixed rate to a usage-based rate

2) To reform the charge policy

3) Clear clarification of the division of responsibility between the government and Vodokanal and establishment of a system

4) Introduction of the concepts of capital reservation and profit reservation – developments of mid- and long-range management plans

5) To design and implement an improvement program for efficient management

6) To design and implement an introduction program for computer system

7) To enrich information disclosure on accountability

8) Introduction of sound accounting principles

9) To inaugurate domestic liaison meetings on reforms in the water works business in Uzbekistan

10) To carry out technology transfer from overseas including the introduction of management techniques.

11) Maintaining and repairing apartment buildings

12) To implement an evaluation of the current facilities and to design an investment plan for new facilities with the aims of improving both the services and the efficiency of management operations

13) Improving other water supply services

14) To prepare and implement an enlightenment and education program to promote water conservation

15) To reform and establish the organization and legal systems, which would enable these targets to be achieved.

(2) The second stage - Establishment of business operations on a self-supporting basis and initial preparations for privatization

(2) The Second Stage - Establishment of business operations on a self-supporting basis and initial preparations for privatization

The targets for the second stage are as follows. With respect to certain of these targets, preparations for a financial system and credit market are stressed as essential external environmental elements, which are too difficult to achieve during the first stage.

1) To establish an efficient system for the collection using bank accounts
2) To implement the collection of charges reflecting mid- and long-term investment costs
3) To raise capital locally through Vodokanal and abroad on overseas credit markets
4) To implement investments in plant and equipment with the aim of improving the efficiency of management
5) To implement a continuous investment plan for sustainable operations
6) To introduce computerization with the aim of achieving labor-saving automation
7) To examine and implement an organization which can take responsibility for excess personnel
8) To stabilize the financial condition of Vodokanal

(3) The Third Stage - Operation on a self-supporting basis and examination of privatization

The targets for the third stage are :

1) To examine privatization and conduct deliberations with the unions
2) To transfer technology to other cities and countries

7.1.3 The Proposed Solutions

In order to achieve the above stages and targets, we propose the following measures to ensure reforms.

(1) The first stage – Requirements for a self-supporting system

1) Converting the charge system from a fixed-rate to a usage-based system

Converting the charge system for the collection of utility charges from a fixed-rate to a usage-based system is necessary so that water consumption is controlled and the water works business can operate as a self-supporting system. However, this has not proceeded as expected due to problems in the method of collecting the meter installment costs, as outlined in Section 3.6.1. The following solutions to this problem are proposed.

Proposed solutions:

i) The costs for the installation costs of meters should be included in the basic utility charges and be collected uniformly from all the water users. A period of 5 years will be necessary to complete the installation which the government has designed.

ii) In this first stage, meters to apartments shall be initially installed only on shared tap. Whether or not a meter is installed for each household depends on the decision of each apartment block.

iii) Vodokanal shall manage the apartments blocks with the shared taps and collect the charges based on the readings of the meters on the shared taps.

2) Changes in charge policy

A new charge policy should be introduced as outlined below along with the conversion of the charge system from a fixed-rate basis to a usage-based system.

Proposed solutions:

i) The revised charge system is designed to facilitate conversion from a fixed-rate to a usage-based rate.

ii) The usage-based system will employ increased block rates in order to encourage the conservation of water.

v) It is necessary to design a charge policy from mid- and long-term point of view as well as a policy which will operate from the present through 5 to 10 years in the future. In this first stage, a period of approximately 3 years is the target period for calculation of utility charges.

vi) The disparity between the charge for the general public and for corporations is regarded as appropriate compared with international standards although the living conditions of the population are a concern.

3) Clear clarification of the division of responsibility between the government and Vodokanal and establishment of a system

It is necessary to clarify the roles played by the government as an administrative body and Vodokanal as a water works business body play. The following points can be stated.

i) A plan for plant and equipment investment is designed and established. For this purpose, Vodokanal should raise the initial funds and handle the construction.

ii) The government should be in charge the expenses related to the various aspects of the social safety net.

iii) In cases where the government exempts an existing form water tariffs, the government should bear the related cost.

4) Introduction of the concepts of capital reservation and profit reservation – developments of mid- and long-range management plans

It is necessary to prepare mid-term and long-range plans for the introduction of the new charge policy for future operation based on a self-supporting system. Therefore, it is necessary to develop mid- and long- range management plans incorporating the concepts of capital reservation and profit reservation to replace the current management strategy which emphasizes single fiscal year accounts.

5) Designing and implementing a program for the improvement of management efficiency

i) Managerial accounting should be introduced. This would include the introduction of an analysis of standard cost and actual budget variance which will lead to cost reduction.

ii) This system aims at an improvement of the incentives for employees which can be achieved by a reexamination of the current personnel evaluation system, the establishment of a proposal system, and the introduction of uniform and quality control activities, and so forth. Moreover, if the results of a comprehensive evaluation of personnel are duly reflected in their wages, a result of a rise in present wage levels should be regarded as inevitable.

6) Designing and implementing the introduction of computerization.

i) As the method of collection is to be changed as a result of the installation of meters, a new computer system needs to be designed and phased in.

ii) With the shift to usage-based charges, the system for the collection charges employing portable terminals.

iii) Improvement of the banking system in Uzbekistan is necessary for the introduction of computerization regarding tariff collection. But at present, the banking system is not enough and population does not use the bank account so much. And so tariff collection is a difficult for Vodokanal from the viewpoint of workload and cost. On the other hand, the introduction of an advance payment system would decrease the workload of tariff collection. If Vodokanal offers a discount for advance payment, the number of users who make payments will increase. Thus discounts are used to make advance payments as attractive option. The introduction of such discount system may be considerable until the banking system is improved.

7) Disclosure of information for the purpose of accountability

i) It will be necessary to introduce a new charge system based on sound financial operations and mid- and long-range plans and prepare cash flow statements for self-financing in the future.

ii) To clarify the entrusted responsibilities of management, it will be necessary to enhance the documents which support water works business report. Reference should be made to various reports including the annual reports disclosed by water works organizations in other countries.

8) Introduction of sound accounting principles

The following points assume that the current system of accounting does not present the reality and should thus be improved.

We propose that :

i) An allowance for repairs be provided based on an evaluation of the current facilities.
ii) The introduction of proper inflation accounting be taken into consideration.
iii) Disclosure of net amounts be charged to disclosure of accounts receivable and advances
iv) Unrecoverable claims be treated as bad debts and covered by an allowance for bad debts.
v) Evaluation of retirement pension property and debt

State-owned retirement pension trustees exist and the following issue concerning retirement pensions does not apply only to Vodokanal. This will be an information disclosure item in the future.

9) Inaugurating domestic liaison meetings to promote reforms in the water works business in Uzbekistan.

The managerial and technical problems have much in common although the locations may differ. Therefore, it is necessary to promote exchanges primarily at the level of the personnel in charge and to inaugurate domestic liaison meetings.

10) Carrying out technology transfer from other countries which are at forefront of the introduction of management techniques

Further technology transfer from overseas should be promoted in order to make the shift to operation on a self-supporting basis. Continuous technology transfer with various countries, including Japan, will be required.

11) Maintaining and repairing apartment buildings.

JEK is in charge of the maintenance and repair of apartment buildings, a current survey shows the need to improve the practice of maintenance and repairs.

12) Conducting an evaluation of the current facilities and designing new investment measures for plant and equipment aiming at improving services and the level of efficiency in business operations.

Many of the present water works facilities were built in the time of the Soviet Union and have already exceeded their period of durability, or will exceed within the next10 years. Although Vodokanal is trying hard to maintain these facilities, there is no statistical data on the period of technical durability remaining. Therefore, a technical re-evaluation of facilities is required.

Due to the introduction of usage-based rates, water consumption is expected to be reduced and the level of the water supply will be also reduced. However, this will create a surplus in terms of the use of the facilities. Therefore with regard to the facilities after water consumption has been, constructing a water reservoir and scrapping outdated plants should be examined. In addition, the reconstruction of certain facilities will be required so that the level of operating efficiency can be improved. Consequently, concrete investment measures for plant and equipment need to be designed.

13) Improving other water supply services

The results of the questionnaire show a great deal of dissatisfaction by the population with the level of water cloudiness. Vodokanal has the responsibility to deliver safe water to the end users as part of its water services, it is necessary to establish an organization, i.e. a water quality management section to settle this kind of issues. The improvement of water supply services is necessary to justify increasing the water tariffs.

14) Designing and implementing an enlightenment and training program to raise public consciousness concerning water conservation.

Vodokanal is taking an active part in publicity on water conservation. However, there is much room for improvement in the substance and means. For example, introducing a way to spread the

information, establishing the necessary organization, and carrying out a training program for water conservation an early age could be added to accomplish this goal.

15) Reforming and establishing organization and legislation to enable the above targets to be met

Measures to meet the targets above would involve changes and the establishment of an organization. In addition, the preparation of legislation is necessary to realize the solutions.

(2) The second stage - Establishment of business operations as a self-supporting system and preparation for privatization

The targets for the second stage are as follows. In the second stage, the implementation of the measures for improvement adopted in the first stage are continued and, thus, the second stage primarily involves a credit market and a financial system which would be difficult in the first stage as they are external elements.

1) Establishing an efficient tariff collection system using bank accounts

If the general public open bank accounts in the future, an automatic deduction system should be introduced. Transactions between the banks and Vodokanal should be dealt with by electronic data processing.

2) Implementing a tariff collection system reflecting mid- and long-term investment costs

After meters have been installed, this system of measurement should reinforce the fundamental rule that the water supply users as beneficiaries bear their own costs so that water tariffs can be rationally reflected in the investment costs of each business operation. Therefore, by designing concrete mid- and long-term investment plans, the sum of such legitimate costs can be incorporated into a usage-based table of utility charges.

3) Implementing fund-raising at home by Vodokanal and abroad through overseas credit markets

Vodokanal needs to raise funds on its own for the legitimate costs involved in future investments in its water works operations. Vodokanal should be able to raise funds by issuing bonds if a domestic credit market is well established. However, if this kind of credit market is not available, Vodokanal needs to look to other parties for financing. In any case, this would require financial stability and some form of guarantee by the government, etc. so that loans can be obtained.

4) Introducing investments in plant and equipment aiming at improving the efficiency of business operations

Investments in plant and equipment should be undertaken with a view to improving the efficiency of business operations based on the measures designed in the first stage.

5) Introducing a computer system to achieve labor-savings automation

A computer system aimed at achieving labor-saving automated should be introduced based on the plan designed in the first stage.

6)Examining and implementing an organization which can take responsibility for the redundant personnel

It is anticipated that a large number of personnel would be redundant as a result of the changes mentioned above. Therefore, the following measures could be taken to cope with these situation:

i) As a result of improvements in management, redundant personnel could be absorbed into newly established or expanded sections. The following sections can be identified as newly established or expanded:

- Cost management section
- Capital section
- Accounting section

- Information management section (computing section)
- Central monitoring center
- Public relations section
- Water quality research section
- Environment section

ii) Introducing a retirement system

7) Financial stability of Vodokanal

As a requirement for privatization, the financial condition of Vodokanal must be stabilized by implementation of the reforms outlined above.

(3) The Third stage – Self-supporting operations and examination of privatization

1) Examination of privatization and holding deliberations with the unions

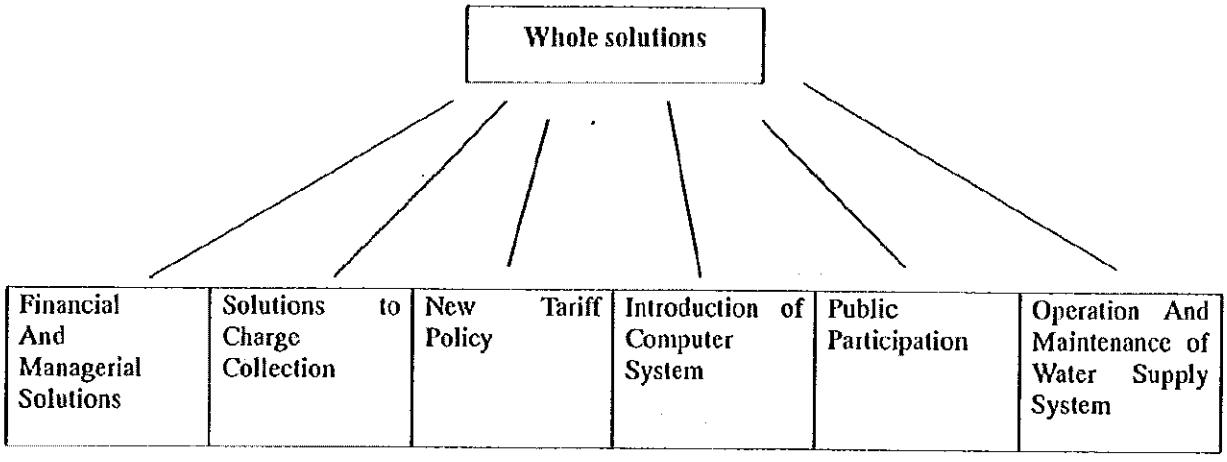
Any decision on privatization with the implication of forming joint-stock companies will require much circumspection. These issues would raise significant problems in reaching agreement with the various unions involved.

2) Technology transfer not only with other cities but also with other countries

It can be safely said that the original goals in reforming the water works business should have been achieved by the third stage. By this time, it should be possible for Vodokanal to transfer technology not only to other cities in Uzbekistan but also to other countries, thus making use of their experience.

7.1.4 Solution to Each Factors

Detailed factors are stated according to the factors as follows.



7.2 Finance and Management

7.2.1 Current Issues

As presented in Fig. 3.6.1 and Fig. 3.6.2 and as outlined in 3.6 Summary of Tashkent city Vodokanal, the current issues of Tashkent city Vodokanal regarding finance and management may be roughly classified as follows.

1) High volume of consumption by the population
2) Cross subsidy
3) Incomplete self-supporting system
4) Shortage of cash for salary payments
5) Low awareness for accountability
6) Inefficient operating activities

7.2.2 Proposals

As countermeasures for these current issues, we considered several proposals which are summarized as follows:

(1) Reconsideration of procedures regarding installation of meters
(2) Conservation of water
(3) Management
    1) Introduction of reserves
    2) Clarification of responsibilities between the government and Vodokanal
    3) Improvements in Management Control
    4) Increase in staff (employee) motivation
    5) Improvement in services
    6) Improvement in Computer System
(4) Technological points
(5) Technology Exchange Meetings
(6) Countermeasures for redundant employees

(7) External Factors

7.2.3 Detail of Proposals

(1) Reconsideration of Procedures Regarding Installation of Meters

1) Cost

In Tashkent the users currently buy the meters, and related regulation officially issued by the Mayor states that payment should be completed within one year of purchase. Chirchik is also following this system. Basically, it would be preferable if the local government were to buy the meters and lend them to the users through Vodokanal. In such case, the total cost would be covered by the water tariff generally and gradually.

2) Technical problems

There are cases where water is supplied to an individual house through multiple pipes. In the end, a one house - one water pipe system would be ideal. Therefore, an estimate of the costs is necessary to make this possible and to solve any problems that may occur during this period. Furthermore it will be necessary to make new laws in this respect. Even if a multiple pipe system is approved in order to obtain a higher total consumption of water, there should be a difference between a shingle pipe and a multiple pipe system. Furthermore, those who do not cooperate in the collect the total water consumption will be penalized. In the case of apartment buildings, one water pipe system shared by a number of people is recommended at first and this will eventually lead to a one house - one water pipe system. As for the payment of water tariffs, it will be based on the number of family members. The details will be determined by Vodokanal. It is necessary to elect a leader at each apartment building who will control the water usage and savings. Since self-government is already existence , we should utilize this principle.

(2) Conservation of Water

At present, Vodokanal is making an effort to promote water conservation among users. The tariff collection is based on a revised tariff table after the installation of meters. Those who installed meters can expect great savings in their water consumption. However people are required to save much more water.

To get the public to understand the necessity of water conservation information, the disclosure of a summary of costs, entries on invoices and newspaper articles on electricity quoting various international figures are required.

Collection of more data and a further analysis of water consumed during the night so that an excessive amount of water is not be used at night by Vodokanal (especially in Tashkent) is also necessary.

(3) Management

1) Introduction of Reserves

Let the public gain a clear understanding of the concept of reserves. The new tariff system is based on 3 year total costs. Therefore, initial funding is abundant, but a separate reserve should be kept for future wage payments. Parameters used at the time when the new tariff system was set up should be used for this gradual payment.

Introduce tariff provisions for large and medium-scale maintenance and repair costs. Let Vodokanal make an estimate of future repairs.

The current depreciation expense based on acquisition costs is too small to replace the water supply facilities due to recent inflation. Although it is said that the Government of Tashkent will

reconsider provisions for replacement costs and large scale repair costs by 2010, it is necessary to evaluate fixed assets and to reflect the necessary cost of reserves in the water tariff.

2) Clarification of Responsibilities between the Government and Vodokanal

Currently, new investments for the expansion of facilities and large-scale replacements are made by the government. In the future, however, Vodokanal needs to reserve capital, the reason being that it is a water supply organization which must function n a self-supporting basis.

On the other hand, budget organizations under the government control costs relating to the social safety net, and water tariff exemption for certain enterprises under government policy. The unpaid receivables of these budget organizations should be paid by the government, and not by Vodokanal.

It is necessary to revise the present tariff system if Vodokanal is to take part in any investment program. A revision of the tariff system is required. At first, Vodokanal will pay a certain percentage of the investment. The government will set up a special account for this purpose.

3) Improvements in Management Control

Management accounting should be employed.

Currently no management target figures or indicates have been determined. The Vodokanal compares actual costs with budget costs and tries to control expenses by keeping to the budget. However, Vodokanal has not established the standard costs and thus even if actual costs exceed budget costs, Vodokanal substantially cannot analyze the reasons for the overrun. As a result, an analysis done by classifying cost into variable and fixed costs has not been carried out. Vodokanal says that they understand that it is necessary to analyze the costs as outlined above, but it is difficult to establish standard costs, especially standard prices due to the high rate of inflation. We believe that cost analysis is important to provide feedback on the business

operations and to improve operating efficiency. As it is necessary to establish standard costs for an effective cost analysis. We propose the following:

i) Vodonakal should employ the management accounting as a mentioned above, and classify the differences between actual costs and the budget costs to the price and quantity differences. Generally speaking, a quantity difference indicates operating efficiency and the Vodokanal can improve its operations by analyzing the quantity differences and feeding this data regarding operation back to each department. As a result, if Vodokanal succeeds in improving business operations and can achieve certain business targets, the benefits from the improvement should be returned to the employees or to the users. Employees would be given some incentive if this system were adopted.

ii) In addition, information on this process should be disclosed to the public.

iii) In order to carry out this type of analysis the Department of Capital Construction or the Planning Department should be expanded or a new Cost Management Center should be established.

iv) The present situation of the water supply facilities should be ascertained. In particular, a thorough assessment of the aggregate amount of the water supply needs to be undertaken.

v) Drawings need to be organized and retained on file. For shortage and retrieval, microfilming might be considered as an option.

vi) The system for disclosing information regarding Vodokanal's business activities should be improved. This can be achieved by publishing a newsletter and an annual report. An awareness of the publications and methods of disclosure employed in foreign countries would be useful for Vodokanal to improve disclosure.

vii) Tariff collection is a difficult for Vodokanal from the viewpoint of workload and cost. On the other hand, the introduction of an advance payment system would decrease the workload of tariff collection. If Vodokanal offers a discount for advance payment, the number of users who make payments will increase. Thus discounts are used to make advance payments as attractive option.

viii) The aggregate amount of cash collected in advance and accounts receivable should be kept separate. At present, Vodokanal nets amount of advance payment against accounts receivable and as a result, these figures are not correctly presented in the balance sheet. It is necessary to segregate these figures in order to accurately ascertain Vodokanal's financial position.

4) Increase in staff (employee) motivation

i) Uniforms are provided to all staff in Vodokanal. This gives the staff self-confidence. This also ensures safety as staff and outsiders can be clearly distinguished. Moreover, any claims from the community can be dealt with promptly. For these reasons, the uniforms should display a logo and should be a distinctive color. Ideas on selection can be collected from the community so that mutual understanding is deepened.

ii) A system should be implemented to encourage suggestions from the staff which would motivate them. Compensation for such suggestions could be given in cash or through a point system as a further incentive. Vodokanal says there is already a similar organization within Vodokanal. If this is the case, it may be necessary to improve how it function. . It would be useful to consider the incentive systems methods employed in foreign countries to improve the suggestion referral system of Vodokanal.

iii) A new section to examine suggestions offered by employees will be set up.

5) Improvement in Services

As a result of revisions to the tariff table, the water tariff will increase. Thus, it is necessary to improve water services as follows for increased utility charges:

i) A section to listen customers' comments set up to improve the customer service.

ii) A public hearing on the revision of the tariff should be held in the community.

iii) As a result of our questionnaire, it would appear that many users have complaints and are concerned about the cloudy appearance of the water. Therefore, a report on water quality for the end users is extremely urgent. A survey section should be formed.

6) Improvement in Computer System

Ideas for the improvement of the computer system are outlined in Chapter 7.5.

(4) Technological points

Ideas for technological improvements are outlined in Chapter 7.7.

(5) Technology Exchange Meetings

In order to implement suggestions, technology exchange meetings involving both management and technical experts should be held on a quarter or semiannual basis between Japan and Uzbekistan.

(6) Countermeasures for Redundant Employees

Employees who become redundant to the plant operations are inevitable due to the decrease in the volume of water consumption in the future. We were informed that there is no age limit system Vodokanal.

Vodokanal should not keep such redundant employees from a financial view point, however, it may be difficult to lay them off because of the existing labor legislation. On other hand, Tashkent Vodokanl entrusts tariff collection and repairs and maintenance of apartment buildings to the JEK and Tashkent City Vodokanal pays the cost 50% of the collected tariffs as repair and maintenance fees and 4% as collection fees. We propose the following countermeasures for surplus employees:

1) Discontinue entrusting repairs and maintenance to JEK. Tashkent City Vodokanal should have redundant employees do repair and maintenance in stead of JEK. Tashkent City Vodokanal will have to prepare a training program for the redundant employees so that they can change jobs. A Repair and Maintenance Department should eventually be spin off as a private company in the future.

2) To introduce the retirement system

(7) External Factors

The points below are external environmental factors related to the water supply project, although they exceed the scope of our suggestions.

1) The present situation of the double exchange rate should be eliminated, in order to reconstruct industries and improve the financial system. It has been estimated that this problem can be solved by the year 2000.

2) It is necessary to improve the banking system and to promote to the opening of bank accounts by the general public.

3) It is necessary to introduce and improve the bond market and the stock market for the promotion of venture business or the privatization of state-owned enterprises.

4) In order to foster the growth of the computer industry, improvement of the leasing market, the protection of intellectual property rights and the strict laws for preventing hackers are necessary. A program for technology exchange and meetings to recruit technicians would also be desirable.

5) The entire communications infrastructure needs to be upgraded. At this point, satellite communication, mobile telephones and "intelligent" terminals can be introduced.

7.3 Tariff Collection

In this section, the Study Team proposes the improved tariff collection procedure.

7.3.1 Improvement Plans on Business Procedures Which Enhance the Effectiveness of Computer Systems

At first we propose some improvement plans on business procedures which will enhance the effectiveness of use of computer systems.

(1) Specialized Staff

Currently at Tashkent Vodokanal, one controller provides most of the services for a particular user in terms of tariff collection, namely, meter reading, billing and tariff collection. We observe that this system is hazardous in view of internal control. If the meter installation plans substantially advance and more than 120,000 water meters are installed for population users, it will be necessary for Tashkent Vodokanal to do their business more efficiently.

We propose that tasks of controllers be separated according to business functions and that controllers be specialists in terms of the business function.

It is not only for efficiency but also for internal control to separate workers who read water meter and workers who collect water tariff. It is a common principle for a medium or big company to assign different persons for billing and repayment respectively, in order to prevent fraud or innocent human errors. We therefore propose that the tasks of the controllers be reviewed and separated into meter reading and tariff collection for purpose of preventing fraud and innocent human errors.

The Water Sales Department is now separated into four groups, namely, industry, communal service, house, and apartment. We propose that these groups be unified and that staff be re-assigned to several sections on the basis of business functions, because we believe that the job rotation can trigger off more dynamic improvements.

In case of Tashkent Vodokanal, however, we think it will not be too ineffective to keep the groups on the basis of user category and to read water meters by each group, because public transport is abundantly available and there are so many users in Tashkent. Therefore we propose the specialist system on the basis of the business function in each group of user category.

Currently there are about 1,000 industry users in Tashkent. Taking into consideration that ten controllers currently assigned for industry users read water meters in 20 working days (1 month), we estimate that one controller reads only 5 water meters per one day. But if each house is equipped with a water meter in future, the number of water meters will be approximately 111,000. There are 15 controllers for house users now. If they read water meters once a month, one controller has to read 370 meters per a day. If they read meters once a quarter, one controller has to read 124 meters per a day. We propose that the number of controllers for meter reading be reviewed and adjusted according to the number of sites visited for meter reading.

In addition to the job restructuring as stated above, we also propose that all controllers be trained to be specialists for a particular business function. If there is a standard method of installation and reading of water meters, it will be easy to change staff in charge of meter reading for industry to meter reading for house. In case the staff in charge of billing is transferred to meter reading, Vodokanal should train the staff how to read meter. But if the staff is already specialist for meter reading, Vodokanal should not train him and can expect him big effect. Specialization of controller is also effective in personnel management.

(2) Standardization of Water Meters Installation

For the effective meter reading, it is essential that the standardization pertaining to water meter installation should be established.

First, we propose the standardization of installation sites of water meters. We propose that the water meters be basically installed outside houses or buildings, so that the staff in charge of meter reading can do their work, even if the user is away from the house or building. It is however

important to maintain the security of water meters to prevent robbery. We then propose that each meter be covered and locked.

Secondly, we propose the standardization of method of water meter installation. The standardization rule should include the appropriate position of water meter, taking into account the easy meter reading, maintenance and exchange of the water meter. It is also necessary to request the user to facilitate the meter reading to access, e.g. not to put items beside the meter.

We believe that the method of water meters installation should be standardized prior to the actual implementation of water meters, otherwise the repair and exchange of installed water meters will burden Tashkent Vodokanal in future.

In view of efficient meter reading, method of water meters installation should not be modified according to the special conditions of particular users. Establishment of standardization will enable the staff in charge of meter reading to serve any users - not of one user category - at particular area.

(3) Frequency of Meter Reading

At the current situation, the meter reading is conducted every month for industry and communal service users, every quarter for population users. Namely, the frequency of meter reading is different depending on the user category. In consideration of effectiveness, all meters should be read by the same frequency, every month in the future. We however conclude that the current frequency should be maintained at the initial stage of meter installation plans.

According to the questionnaire survey, it takes one controller about 25 minutes on average to read water meter for an industry or communal service user. If it is abolished to read water meters in presence of users, and it is established to standardize water meters installation to use hand-held terminals for meter reading, etc, we estimate that it will take one controller only 13 minutes to read water meter for an industry and communal service user. One staff in charge of meter reading will be able to read 23 meters per one day. There are about 10,000 industry and communal

service users, Vodokanal needs at least 23 staffs in charge of meter reading every month.

The same questionnaire survey showed that a controller for house users takes about 12 minutes on average to read water meter per a user. Assuming the improvement plans similarly as stated above, we estimate that a controller will take only 7 minutes to read one water meter. If a controller can spend five hours for meter reading, and two hours for travelling from place to place, he will be able to read 46 water meters per one day. If monthly meter reading is conducted, Tashkent Vodokanal will need 121 staffs in charge of meter reading, 61 staffs in case of bi-monthly meter reading, and 41 staffs in case of quarterly meter reading.

Finally according to the same questionnaire survey, one controller for apartment users takes about 10 minutes on average to read water meter. Under the same assumptions, we estimate that the controller will be able to read meter within 5 minutes. Assuming that approximately 10,000 apartment buildings are equipped with water meter, we estimate that Tashkent Vodokanal will need at least 10 staffs in case of monthly meter reading, 5 staffs in case of bi-monthly meter reading, and 4 staffs in case of quarterly meter reading respectively.

Supposing that the number of controllers at Tashkent Vodokanal will not increase and that all controllers take charge of meter reading, we estimate that the number of staff in charge of industry and communal service users will be at least 21. The total number of staff in charge of house and apartment users is only 35. It will be impossible to read all water meters by the current controllers only.

We suggest that it is necessary to improve tariff collection procedures, especially meter reading procedures. Taking into account the finance of Tashkent Vodokanal and the ability of users to pay at one time, the frequency of meter reading should not excessively reduced. So our conclusion is that meter reading for population users should be conducted once a quarter. In the next section, we propose tariff collection procedures according to this conclusion.

Table 7.3.1 Human Resource

	Industry	Communal	House	Apartment
Number of Meters	1,000	9,000	111,000	10,000
Meter Reading Time Per a User (minutes); 1999	25	25	12	10
Meter Reading Time Per a User (minutes); 2004	13	13	7	5
Number of Meter Reading Sites Per a Controller & Per a Day.	23	23	46	55
Number of Staff for Meter Reading ; Monthly Meter Reading	3	20	121	10
Number of Staff for Meter Reading; Bi-Monthly Meter Reading	-	-	61	5
Number of Staff for Meter Reading; Quarterly Meter Reading	-	-	41	4

(4) Norm Users

While the meters installation plan should go ahead, norm users may be going to still exist although there are not many. It is thus necessary to make a guideline of tariff collection from norm users.

We propose that norm users keep their bill for a whole year and that they pay the divided amount every month. If a norm user pays in advance, the tariff will be discounted. Oppositely, if he pays in arrears, the penalty will be charged.

Since a norm user does not have a water meter, Vodokanal does not need to conduct meter reading. Instead, we propose that Vodokanal send a bill for the next year at the end of every year. The staff in charge of tariff collection should check whether norm users have paid or not. If a norm user has paid in arrears or not paid yet, he should be imposed more penalty and earlier than the users who have water meters. In addition, the grace period before suspension of water supply for norm users should be shorter.

Regarding the norm users, we propose that Water Sales Department monitor them in view of payment, not water consumption. On the other hand, it is important to request norm users to have keen awareness of water saving. In other chapters, we describe our proposals on education or publicity of water saving, repair or maintenance piping and equipment, and so on.

(5) Apartment Users

Regarding the apartment users, it is better to install a water meter at all apartment household in the future, but in short term we propose that a water meter should installed at all apartment buildings so that Tashkent Vodokanal monitors each building's water consumption. Vodokanal also should control all water meters that are installed for whole apartment building.

We propose that Vodokanal make a contract with representative (probably JEK or the apartment council) which collects tariff from each household user. Vodokanal will read meter installed at apartment buildings, and divide the total water consumption by number of households of the apartment. The water tariff per household will be estimated by the divided consumption. Then the total tariff of the apartment will be calculated by multiplying the water tariff per household by the number of households. The reason why the tariff calculation will be so complicated is that the proposed tariff table is progressive, and the apartment users would have to pay comparatively more amount of water tariff, than the other users, if the total consumption amount would be the basis of tariff calculation. Vodokanal will then collect tariff from representative according to the schedule of meter reading.

7.3.2 New Tariff Collection Procedures

In this section, the Study Team describes our proposals on not only installation of computer systems at Vodokanal but also effective work and improvement plans of quality of works by using computer systems.

The proposed procedure is based on the improvement plans described in previous section, as well as some other factors which are scheduled to almost complete in 2004.

The fundamental policy in establishing the appropriate tariff collection procedures is that simple tasks should be automatically operated by using the computer systems as much as possible. Namely the human resource should be allocated on more important tasks which cannot be done by a computer;

planning, decision making etc. The computer systems should be used strategically, not just as a data storage.

(1) Application for Water Supply and Change of Condition

We propose that Vodokanal establish a new section, Customer Service Desk, which will process applications for water supply and the change of user's conditions. Customer Service Desk will also receive the information about faulty of water meters, pipes, or other equipment from users, answer the queries regarding the tariff, collect requests to improve quality of supply water and so on from users. One of their key works will be receiving application for water supply and change information of user's condition.

Customer Service Desk should cover all users – industry, communal service, house and apartment.

1) Application for Water Supply

We propose that a particular form for application for water supply be prepared at Vodokanal. New users should come to Vodokanal, fill the form including the date to start using water and submit it to Customer Service Desk. At the desk, a simple check should be carried out. If all information is appropriately filled in form, the staff should input the information into the computer system subsequently. At the same time, the computer system automatically should issue the user number uniquely allocated for the user. This user number will be a key item in the computer system.

We propose Technical Department be also able to access the computer data provided by the users. Technical Department should check the data every day and make a plan to visit new users who have applied for water supply. The staff at Technical Department will visit the user, open the water plug, inspect water meters, and seal the meter on the requested starting date to use supply water.

If a user constructs a new house or a building where a water meter should be equipped, the

user should discusses the meter installation, piping and water equipment and other technical matters with Vodokanal in advance. After that, Vodokanal should install a water meter installation. On the first day to use water, Technical Department should do the aforementioned tasks.

After all procedures are finished, Technical Department inputs information including the date and figures indicated by the water meter.

2) Change of Conditions

The procedures of change of user's conditions are almost same as those of application.

We propose that a particular form for change of user's conditions be also prepared at Vodokanal. The user should visit Vodokanal, fill in the form and submit it to Customer Service Desk. At the desk, a simple check should be carried out. If all information is appropriately filled in the form, the staff should input the information into the computer system subsequently.

If change of conditions requires actions by other departments, Customer Service Desk should distribute a memorandum which is printed out from computer system to the departments where appropriate actions should take place. After they finish processing, they should return the memo to Customer Service Desk after signing it. Customer Service Desk should input information and the user conditions will be changed in the computer system.

(2) Meter Reading

In this section we propose the meter reading procedures, which will be operated by the staff in charge of meter reading at each group categorized by users. We also propose the staff in charge of meter reading should be assigned for almost fixed users and areas to read water meter.

1) Preparations

The frequency of meter reading for house and apartment users should be once a quarter. So

whole Tashkent area will be divided into three areas. It is important to equalize the number of users and estimated collection amount of water tariff at each area. Each area is divided into the number of staff in charge of meter reading. So meter reading of one area is finished in one month. This master plan for meter reading should be inputted into the computer system. The computer system will make automatically schedule for each staff.

The staff in charge of meter reading should follow the schedule produced by the computer system. They should visit Vodokanal every morning and check their own schedule and the area for meter reading. They will then confirm the information on users whom they are scheduled to read meter on that day and download it to a memory card of hand-held terminal.

2) Meter Reading at User Sites

The staff in charge of meter reading should input the figure indicated by the water meter into their hand-held terminal at the user sites. They will then print out a slip specifying the results of meter reading, and leave the slip in the users post. The slip should not be used as a bill but only as a notice of meter reading.

If malfunction of water meter or water robbery is discovered, the staff should not read the users meter and do appropriate treatment accordingly. He should then write down the situation to process at Vodokanal office later. It will be necessary to prepare a manual book to process irregular cases and provide staff in charge of meter reading with necessary training.

3) Post-processing

After staff in charge of meter reading finishes his schedule of meter reading for a day, he should upload the meter reading data accumulated in memory card of hand-held terminal to the computer system at Vodokanal.

After data is uploaded, validity checks should be conducted by the computer system, for example, whether the result of meter reading is too big or small, whether the water consumption decreases or increases too much compared to past records. The computer system

should print out the list of such data that is supposed to be invalid. The staff in charge of meter reading should then research and correct the figure if necessary. If the tariff is adjusted, a new bill should be sent to the user as soon as possible.

If any breakdown or malfunction is discovered, staff should input the information into computer system according to his note. Technical Department will then be able to identify where repair is required. After the repair, the department should update the data on the computer system. On the other hand, other conditions which do not relate to Technical Department should be printed out from the computer system by staff in charge of meter reading. The printed list should be distributed to relevant departments for their treatments.

We propose that the departments which will not access the computer systems inform the staff in charge of meter reading about the treatment to facilitate him to update the data.

(3) Billing

We propose that billing procedures be undertaken by dedicated staff who should print out the bills specifying water tariff calculated by the computer system according to meter reading results, and distribute the bills to users. For norm users, the staff in charge of billing should distribute a bill for the whole year to them once a year.

In the future, when the number of user who pays water tariff through his bank account increases or the average personnel expense in Uzbekistan increases, we propose that Vodokanal should mail bills to users instead of human distribution.

1) Users with Water Meter

The tariff should be automatically calculated by the computer system according to meter reading results accumulated in computer system. Only confirmed data should be only processed for calculation. The computer system should also calculate the exemption and discount of water tariff so that staff will not have to carry out complicated calculation.

However the staff should check the changed tariff amount which is led by the irregular list, broken meter or equipment, etc. The staff checks whether all treatments are appropriately done or not. In case of changing tariff amount, the staff in charge of billing should send correct bill to the user as soon as possible likewise the correct slip by the staff of meter reading.

The computer system should automatically determine the date payment due. The computer system should print out a bill specifying a tariff amount and payment due. Then the staff in charge of billing should distribute bills to all users.

2) Norm Users

The staff in charge of billing should distribute a bill for the whole year to norm users nearly at the end of every year. The bill should be composed of monthly payment slips, bi-annual payment slips, and an annual payment slip. If a user pays the tariff bi-annually or annually in advance, his tariff amount should be discounted.

Norm users can also choose automatic bank transfer facility optionally. In this case, the staff in charge of billing should print out notice of deduction from user's bank account from the computer system and distribute them to the users, instead of sending a bill to users. The frequency of sending the notice should tally with that of meter reading, i.e., every month, every six months or every year.

3) Automatic Transfer Facilities

Supposing that the financial systems in Uzbekistan develops and more people have their own bank accounts, Vodokanal should urge the users to utilize automatic transfer facilities. If a user applies it and pays all the amount by the due date, his tariff should be discounted.

For the automatic transfer facilities of water tariff, a user will have to open his own bank account. Because increase of bank accounts might satisfy with bank, Vodokanal should urge the users to utilize automatic transfer facilities and negotiate about transfer fee with bank.

Moreover, we propose all other public service organizations including gas, electricity, and telephone should cooperate with banks to promote the automatic transfer facilities of public charges. The cooperation should contribute to establish financial and banking system all over Uzbekistan.

(4) Receipting

In this section we describe the proposed tariff collection procedures. We propose that the tariff collection section collect water tariff from all of four user groups. The staff at collection section should not visit the users to collect tariff, and process automatic transfer facilities and payment at bank or post office.

Without cooperation of banks, it will be impossible to exchange payment orders and information on tariff collection by electronic data between Vodokanal and the banks. Currently, payment orders and information on tariff collection are printed out from the computer systems at Vodokanal and banks respectively. By using the data kept in each computer system, we believe that it is comparatively easy to realize the digital data exchange.

1) Dispatching Digital Data to Banks

Firstly, tariff collection section should download the inevitable information about automatic transfer facilities, including user code, bank account code, transfer date, tariff, and order number into a magnetic tape or a floppy disk several days prior to the transfer date.

There will be a need to implement the sufficient security measures for this procedure because a large amount of money will be involved. For example, the staff who will process this task should have a special password allocated only for this work. The two staff should attend the operation of electronic data for the internal control.

The staff should then bring the electronic data to banks for their processing.

2) Receiving Digital Data from Banks

The users who do not utilize the automatic transfer facilities will pay at bank or post office according to the distributed bill. Vodokanal should discuss with banks or post office about easy way to pay for users. When the user pays at bank or post office, he does nothing but telling that he is going to pay water tariff. By only telling that, the money should be transferred to the bank account of Vodokanal.

Vodokanal will then be informed by the banks that the user has paid at bank or post office.

The tariff collection section will get the cash-in information from bank by electronic data. The cash-in information should include user code, user account code, tariff, and cash-in date.

After the data is transferred to the computer system, the balance of user accounts will be checked. If the amount of cash-in matches with the credit amount, the balance will be automatically cancelled. Otherwise, the staff in charge of tariff collection should print out the list of unmatched credit data from the computer system, for further investigation and appropriate action.

(5) Outstanding Tariff Control

We propose that the tariff collection section monitor the cash-in information before and after due date, while the staff in charge of outstanding tariff control should deal with outstanding tariff over the given days after due date.

1) Overdue Control

After due date of payment, the computer system should automatically print out the payment list, notification of overdue, and request for payment. The staff in charge of outstanding tariff control should bring the notification to the users to urge them to pay the outstanding tariff.

The outstanding users should pay penalty, which will be specified in the notification of

overdue and request for payment. The implementation of penalty implies two things. The first is that the cost of outstanding tariff control should be shared by outstanding users who are the cause of the cost. The second is that penalty will promote smooth tariff collection.

During the certain period, the staff in charge of outstanding tariff control should print out the list of outstanding users and notification of overdue, and request payment from the computer system. The staff should visit outstanding users with the notification every day.

After the period, the staff should visit the users to request payment several times. Even if the user has not paid, then Vodokanal should submit the final request to the user. After various factors are examined, for example, user's willingness to pay or partial payment, water supply should be suspended.

2) Important Control

In addition to the outstanding tariff controls as stated above, the computer system should print out a credit aging list covers from the credit occurrence day to present day and the breakdown table are printed out properly from computer system. We propose the chief of outstanding tariff control should treat the more important outstanding by using the aging list and the breakdown table, instead of routine outstanding control. Namely the chief conducts emphatically the more important outstanding control - older or bigger outstanding tariff.

(6) The Accounting Information, Reporting

We propose that the regular reports, lists and accounting data be processed automatically by the computer system.

1) Accounting Information

We propose that the accounting and financial data be transferred automatically to the Prime Cost Calculation System (Accounting System) every day.

At the time of proceeds marking, water tariff is automatically calculated according to meter

reading data whose status is determination. The total tariff amount for one day should be transferred to the Prime Cost Calculation System as journal of account receivable and sales. If a user has paid in advance, the same amount should be reduced from account receivable and transferred to the Prime Cost Calculation System.

At the time of cash-in, the computer system should check the account receivable, make journal and transfer it to the Prime Cost Calculation System. If a user has paid more than the amount of account receivable, the advanced received journal is made and also transferred to the Prime Cost Calculation System.

The computer systems should process the above tasks, so that the staff of Water Sales Department will be able to submit the accounting information every day without doing any tiresome procedures. We also suggest that the staff had better check the total amount once a month.

2) Reporting

The computer system should have reporting function including the list of sales, account receivable, and cash-in. These lists should be printed out regularly as the computer system will have a capacity to produce them timely and instantly.

We also propose that the computer system have function of exporting data to package software, on condition that sufficient security measures are implemented. Vodokanal can do readily strategic works e.g. plan and achievement analysis, management index analysis, and other analysis by using download function and table calculation packaged software. It is useless, however if the staff can not use the package software. We propose the computer training for end users should be conducted.