Sanitation Company of the State of São Paulo
(Sabesp)

The Preparatory Survey on Water Loss Control and Reduction, and Energy Efficiency Program in the State of São Paulo in the Federative Republic of Brazil

Final Report Summary

February 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

Chuo Kaihatsu Corporation

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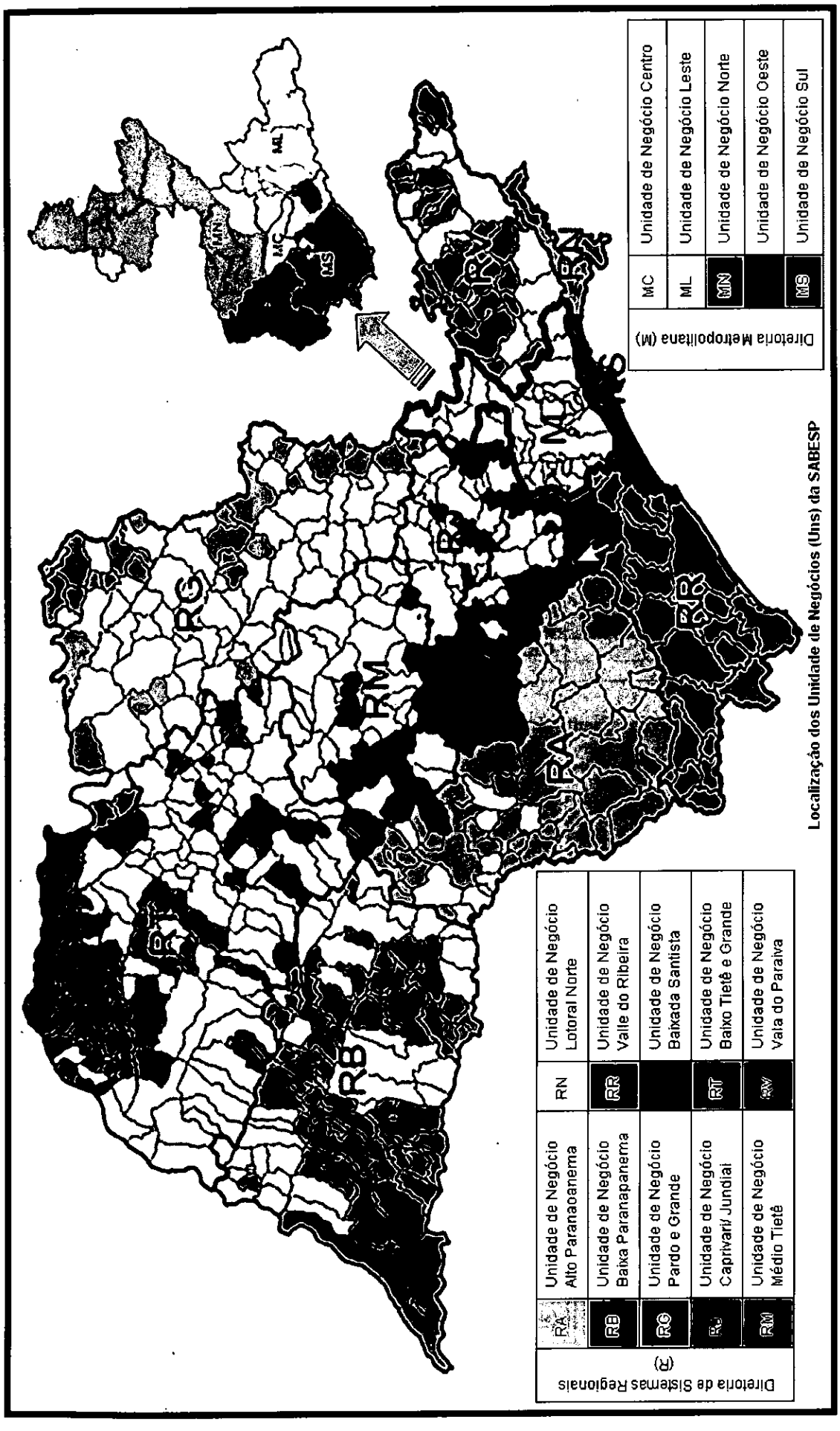
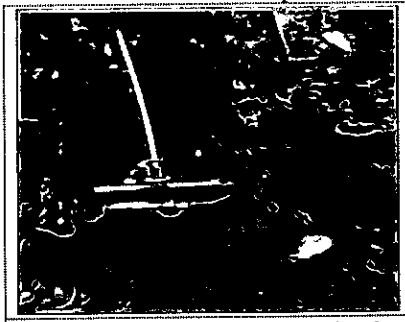
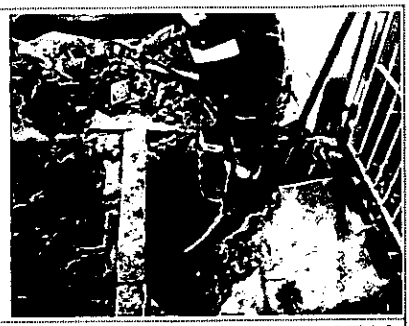
Exchange Rate

Currency used - Real
The exchange rate prevailing in October 2007 is shown below:
US$ 1.00= R$ 1.801 (Banco Central do Brasil Average TTB Rate Oct/2007)
US$ 1.00= ¥116.81 (Bank of Tokyo-Mitsubishi UFJ Average TTS Rate Oct/2007)

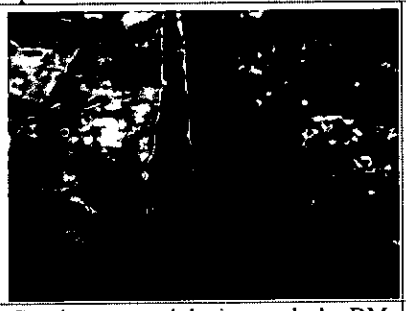

Localização dos Unidade de Negócios (Uns) da SABESP
Diretoria de Sistemas Regionais (R)
RA
RB Unidade de Negócio Alto Paranaoanema
RB Unidade de Negócio Baixa Paranapanema
RG Unidade de Negócio Pardo e Grande
RJ Unidade de Negócio Capivari/ Jundiaí
RM Unidade de Negócio Médio Tietê
RN
RR Unidade de Negócio Lotoral Norte
RR Unidade de Negócio Valle do Ribeira
Unidade de Negócio Baixada Santista
RT Unidade de Negócio Baixo Tietê e Grande
RV Unidade de Negócio Vala do Paraíva
Diretoria Metropolitana (M)
MC Unidade de Negócio Centro
ML Unidade de Negócio Leste
MN Unidade de Negócio Norte
Unidade de Negócio Oeste
MS Unidade de Negócio Sul
RB
RG
RJ
RM
RR
RT
RV
MC
ML
MN
MS

Photos related to actions under the Water Loss Control and Reduction Program

A-1-1 Branch Line Replacement

		
Branch line replacement works by DM;	Water connection by NDM	Water connection by NDM (customer's side)

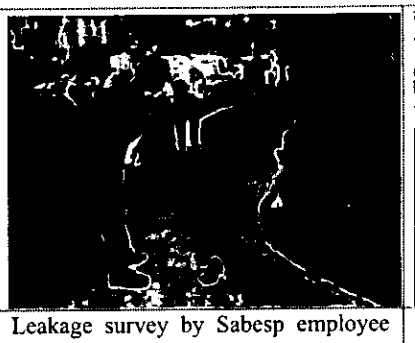
A-1-2 Networks and branch line replacement

		
Network laying works by DM	Cast iron network laying works by DM	Electrofusion junction welding work in PEAD pipe for NDM

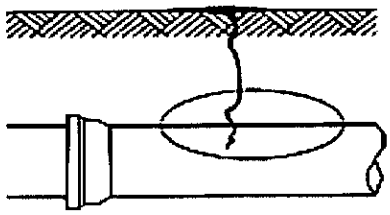
A-1-3 Branch Line Replacement – Leakage Survey

		
Pavement opening for branch line repair	Crack leakage in PEAD (black)	Leakage repair and branck line replacement

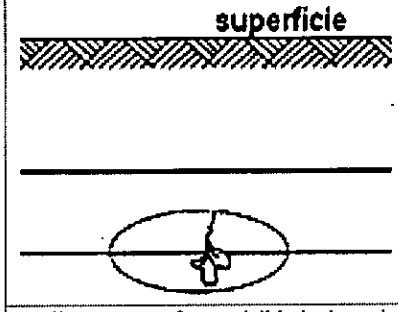
A-2 Non-Visible Leakage Survey

		
Leakage survey by Sabesp employee (sidewalk)	Leakage survey by Sabesp employee (sidewalk)	Installation for tests by Sabesp technicians and ousourced workers

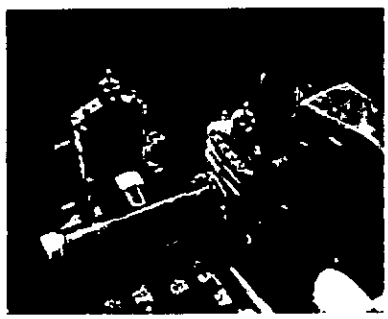
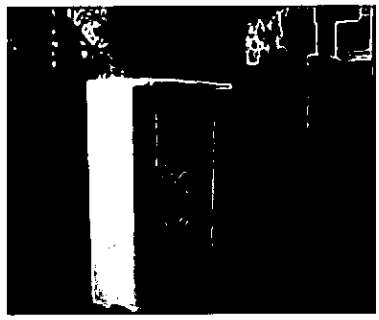
A-3-1 Leakage Repair in Network

		
Type of network leakage	Opening for visible leakage repair	Visible leakage in high-pressure water area

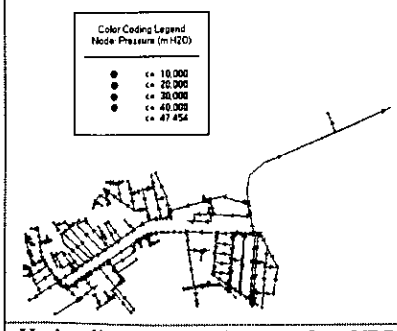
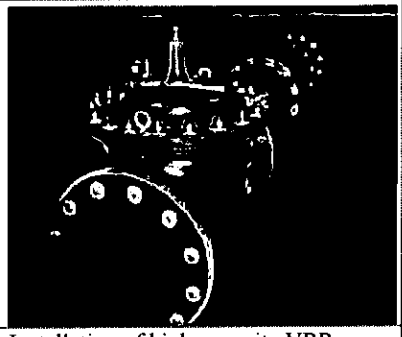
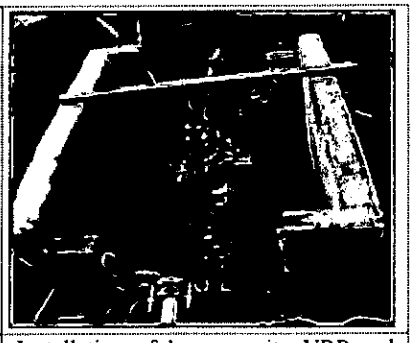
A-3-2 Non-Visible Leakage Repair (Network)

		
Ordinary type of non-visible leakage in networks	Leakage repair in 75-mm network from the 1970s	Network leakage (ring bursting)

A-4-1 Sectorization

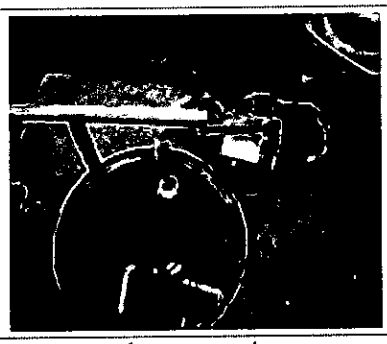
		
Installation of 300-mm valve for sectorization	Installation of high-capacity valve	Installation of water volume measurement in sector

A-4-2 VRP

		
Hydraulic simulation of VRP installation	Installation of high-capacity VRP	Installation of low-capacity VRP and construction of VRP chamber

A-4-3 DMC

Installation of valve DMC implantation



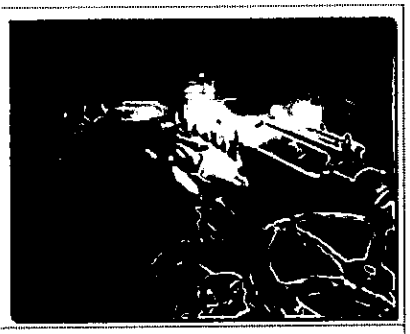
Flow volume and pressure measurement in bypass pipe at DMC inlet

Installation of DMC measurement equipment

A-4-4 Booster

Booster maintenance operation

Booster maintenance operation



2 Boosters

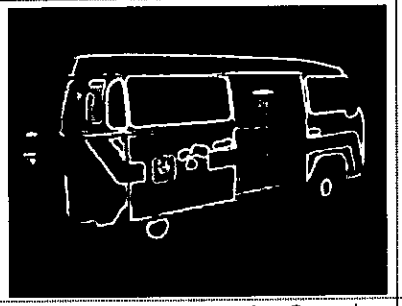
A-4-5 Slum closing

Slum area located near the hill

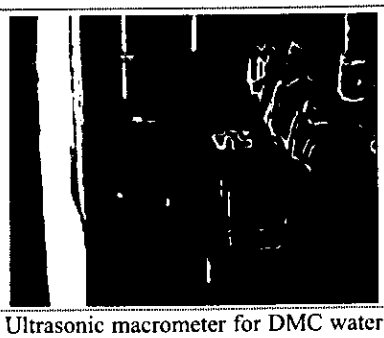
Slum entrance

Measurement of flow volume to slum area

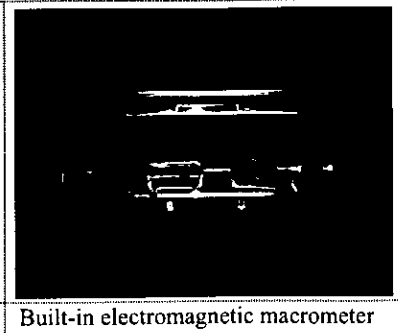
A-5 Equipment



RG Maintenance and Operation Equipment

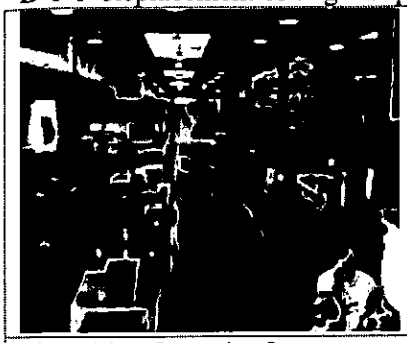
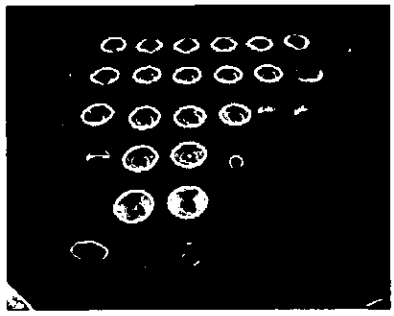
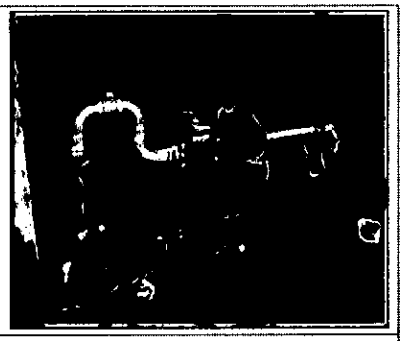


Ultrasonic macrometer for DMC water volume measurement

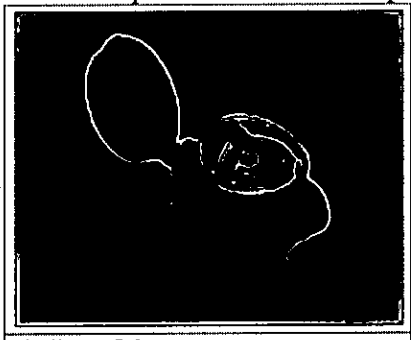
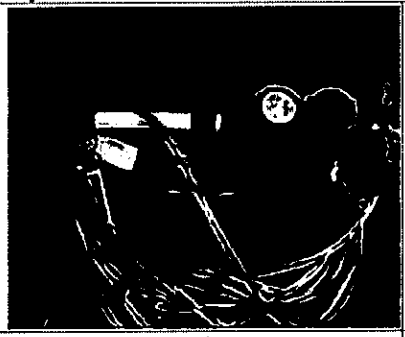
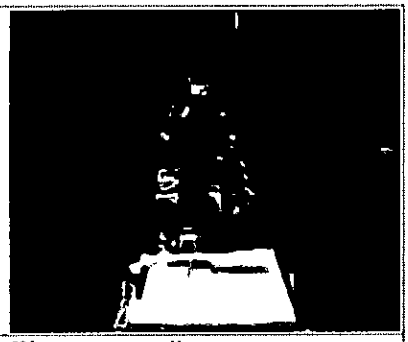


Built-in electromagnetic macrometer

B-1-1 Replacement of High-Capacity Water Meters

		
Watere Meter Inspection Center	High-capacity water meter test	Rack and high-capacity water meter

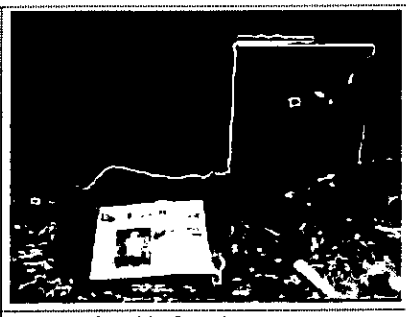
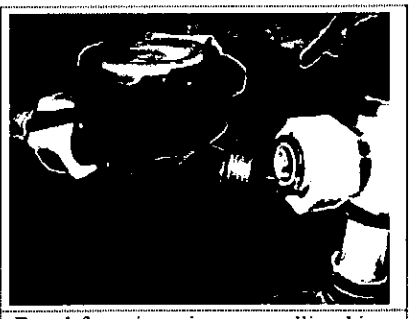
B-2.2 Replacement of Low-Capacity Water Meters

		
Ordinary Sabesp water meter	Rack and low-capacity water meter	Water meter quality test

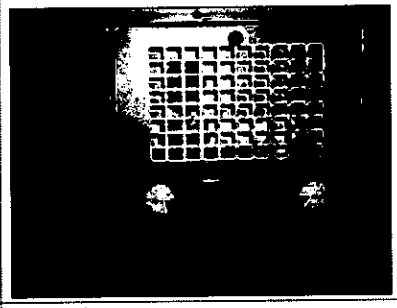
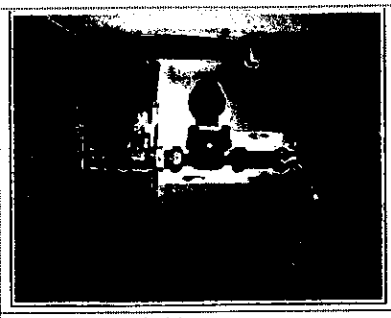
B-2-1 Inspection of inactive connection

		
Connection inspection by Sabesp employee	Connection inspection and form filling by Sabesp employee	Connection inspection and form filling by Sabesp employee

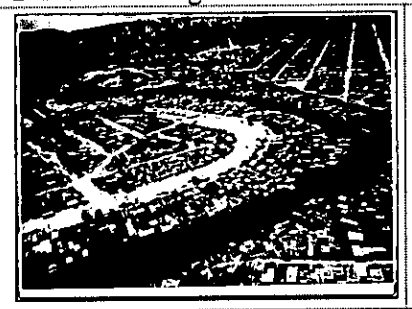
B-2-2(1) Irregularity Control

		
Evidence of bypass fraud before the water meter	Bypass fraud before the water meter	Fraud from inserting a metallic object to reduce water meter rotation and prevent measurement

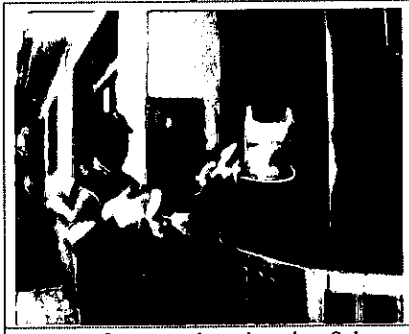
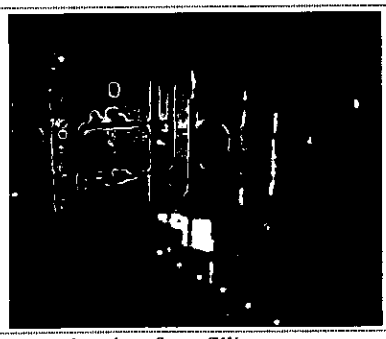
B-2-2(2) Installation of UMA - Irregular Connections

		
UMA installation work	UMA door	UMA internal side

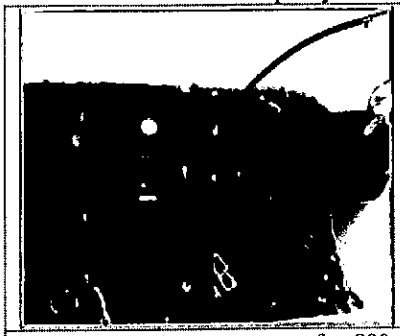
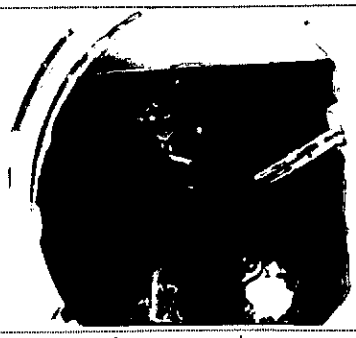
B-2-3 Slum regularization

		
Urban area in the municipality of São Vicente, coastal region of SP State	Slum settled from the entrance to half of the hill	Irregular branch line connection in slum (squatted area) – São Paulo

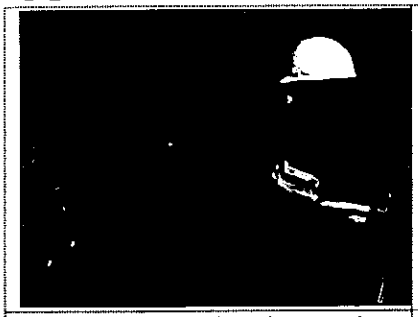
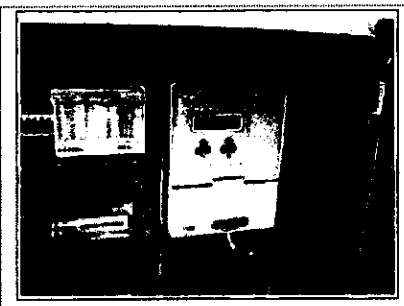
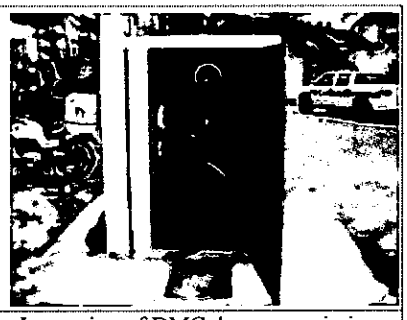
B-3 Record Update

		
Survey for record update by Sabesp employee	Form for record update survey	Record update form filling

C-1 Installation/Adequacy of Macrometers

		
Electromagnetic macrometer for 800-mm pipeline	Built-in electromagnetic macrometer for 400-mm network	250-mm electromagnetic macrometer at DMC inlet

C-2 Macrometer Calibration

		
Inspection of electric and automation equipment	Electric panel and IHM – electromagnetic flow meter	Inspection of DMC data transmission equipment

C-3 Capacity Building

		
International Seminar (Latin America) sponsered by Sabesp	Workshop organized by Eficaz group	Workshop organized by Eficaz group

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Final Report
Summary

Contents

ACRONYMS

Acronym	Full Name
ABENDI	Brazilian Non-Destructive Essay and Inspection Association
ABNT	Brazilian Association of Technical Standards
ANA	National Water Agency
ARSESP	Sanitation and Energy Regulatory Agency in the State of São Paulo
BEI	European Investment Bank
IDB	Inter-American Development Bank
IBRD	The World Bank
BNDES	Banco Nacional de Desenvolvimento Econômico e Social
BOVESPA	São Paulo Stock Exchange
CAF	Andean Development Corporation
CEF	Caixa Econômica Federal
CEQ	Qualification Examination Center
CETESB	Companhia de Tecnologia de Saneamento Ambiental
CJI	Inter-American Investment Corporation
ConCidades	City Council
COFIEX	Foreign Financing Commission
CREA	Engineering, Architecture and Agronomy Council
CS	Superintendence for Strategic Supply and Contracting
ETA	Water Treatment Plant
ETE	Sewage Treatment Plant
FIDA	Inter-American Fund for Agricultural Development
FoFo	Cast iron
FONPLATA	Plata River Basin Development Fund
FUMIN	Multilateral Investment Fund
GEF	Global Environment Facility
GESP	Government of the State of São Paulo
IPDt	Water loss rate
IPT	Technological Research Institute
IWA	International Water Association
JBIC	Japan Bank For International Cooperation
JICA	Japan Bank For International Cooperation
KFW	Kreditanstalt Fr Wiederaufbau
M	Metropolitan Division
MA	Metropolitan Water Production Business Unit
MC	Central Business Unit
ML	East Business Unit
MN	North Business Unit
MS	South Business Unit
MO	West Business Unit
MOE	West Operation Engineering Department
MOET	West Loss Control Division
Mca	Water column meter
MP	Metropolitan Superintendence for Planning and Development
MPI	Metropolitan Integrated Planning Department
ODA	Official Development Assistance
PAC	Growth Acceleration Program
PCH	Small Hydroelectric Plant
PLANAB	National Environmental Sanitation Plan
PLANASA	National Sanitation Plan
Pmédia	Average pressure
RMSP	São Paulo Metropolitan Region
R	Regional System Division
RA	Alto Parapanema Region Business Unit

Acronym	Full Name
RB	Baixo Parapanema Region Business Unit
RG	Pardo and Grande Region Business Unit
RJ	Capivari / Jundiaí District Department
RM	Médio Tietê Region Business Unit
RN	North Coast Region Business Unit
RR	Vale do Ribeira Region Business Unit
RS	Baixada Santista Region Business Unit
RT	Baixo Tietê and Grande Region Business Unit
RV	Vale do Paraíba Region Business Unit
RO	Superintendence for Management and Operational Development of Regional Systems
ROP	Loss Control and Operational Planning Department
SABESP	Cia. de Saneamento Básico do Estado de São Paulo
SCORPION	Operation Control, Problem Resolution and Information System
SENAI	National Industrial Learning Service
SGH	Water Meter Management System
SIGAO	Service Management System
SIGNOS	Sanitation Geographic Information System
T	Technology, Undertaking and Environment Department
TO	Superintendence for Operational Development
TOE	Engineering and Operation Department
UGP	Project Management Unit
UN	Business Unit
UMA	Water Measurement Unit
Vaz.	Leakage
VRP	Pressure Reduction Valve
ZA	High Zone
ZB	Low Zone
ZM	Middle Zone
ABENDI	Brazilian Non-Destructive Essay and Inspection Association
ABNT	Brazilian Association of Technical Standards
ANA	National Water Agency
ARSESP	Sanitation and Energy Regulatory Agency in the State of São Paulo
BEI	European Investment Bank
BID	Inter-American Development Bank
BIRD	The World Bank
BNDES	Banco Nacional de Desenvolvimento Econômico e Social
BOVESPA	São Paulo Stock Exchange
CAF	Andean Development Corporation
CEF	Caixa Econômica Federal
CEQ	Qualification Examination Center
CETESB	Companhia de Tecnologia de Saneamento Ambiental
CJI	Inter-American Investment Corporation
ConCidades	City Council
COFIEX	Foreign Financing Commission
CREA	Regional Engineering, Architecture and Agronomy Council
CS	Superintendence for Strategic Supply and Contracting
ETA	Water Treatment Plant
ETE	Sewage Treatment Plant
FIDA	International Fund for Agricultural Development
FoFo	Cast Iron
FONPLATA	Fund for Development of Plata River Basin
FUMIN	Multilateral Investment Fund
GEF	Global Environment Facility
GESP	Government of the State of São Paulo
IPDt	Water Loss Rates

Acronym	Full Name
IPT	Technological Research Institute
IWA	International Water Association
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
KFW	Kreditanstalt FrWiederaufbau
M	Metropolitan Division
MA	Metropolitan Water Production Business Unit
MC	Central Business Unit
ML	East Business Unit
MN	North Business Unit
MS	South Business Unit
MO	West Business Unit
MOE	West Operation Engineering Department
MOET	West Loss Control Division
Mca	Water column meter
MP	Superintendence for Subway Planning and Development
MPI	Integrated Subway Planning Department
ODA	Official Development Assistance
PAC	Growth Acceleration Program
PCH	Small Hydroelectric Plant
PLANAB	National Environmental Sanitation Plan
PLANASA	National Sanitation Plan
Pmédia	Average Pressure
RMSP	São Paulo Metropolitan Region
R	Regional System Division
RA	Alto Paranapanema Region Business Unit
RB	Baixo Paranapanema Region Business Unit
RG	Pardo and Grande Region Business Unit
RJ	Capivari / Jundiaí District Department
RM	Médio Tietê Region Business Unit
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RS	Baixada Santista Region Business Unit
RT	Baixo Tietê and Grande Region Business Unit
RV	Vale do Paraíba Region Business Unit
RO	Superintendence for Management and Operational Development of Regional Systems
ROP	Loss Control and Operational Planning Department
SABESP	Companhia de Saneamento Básico do Estado de São Paulo
SCORPION	Operation Control, Problem Resolution and Information System
SENAI	National Industrial Learning Service
SGH	Water Meter Management System
SIGAO	Service Management System
SIGNOS	Sanitation Geographic Information System
T	Technology, Undertaking and Environment Department
TO	Superintendence for Operational Development
TOE	Engineering and Operation Department
UGP	Project Management Unit
UN	Business Unit
UMA	Water Measurement Unit
Vaz.	Leakage
VRP	Pressure Reduction Valve
ZA	High Zone
ZB	Low Zone
ZM	Middle Zone

GLOSSARY

Term	Description
Water balance	Scenario, based on the model proposed by IWA, which seeks to show, based on data obtained from measurements and estimates, the annual water volume supplied to UN, the annual volume of distributed water use and the annual water loss volume, in addition to include the several water loss components in the evaluation of the technical feasibility of such data collection.
Authorized consumption	Volume of treated water consumed by active connections.
Unattended authorized consumption	Authorized consumption volume related to own use, operational use, and special use volumes.
Economy	Sanitation service consumption units; it may be residential, industrial, commercial or public; for buildings with several floors and some condominiums, a single connection serves more than one economy.
Loss Reduction Task-Force - IWA	Water Loss Task Force – work group constituted in IWA to disseminate and develop studies leading to "best water operation practices", focused on loss reduction actions.
Distribution Infrastructure	It comprises the equipment necessary for treated water distribution to consumers, reservoirs, piping, valves, connections and pumps, which constitute the water distribution network and connections
Active connection	Water connection in operation, which contributes to the Company's revenues in the respective period.
Water connection	Water distribution system device that allows the connection between the distribution network and the consumer's real estate; it comprises the branch line, the rack and the water meter.
Inactive connection	Water connection recorded as disabled in SABESP commercial system, without contributing to the Company's revenues in the respective period.
Macromeasurement	A system integrating Measurement Points, the volumes of which are measured (by water meters = macrometers), or estimated /calculated; this system controls the volumes flowing through water treated pipeline system, volumes collected and produced by ETAs, as well as volumes exported, transferred and delivered to UNs and concessionaires.
Micromeasurement	Flow meter system (water meters) that control the volumes supplied to SABESP consumers (residential, commercial, industrial and public)
Model for simulation of effects of loss reduction and control actions	Computer-based model used as a tool to give priority to low reduction and control actions by simulating the effects of such actions.
Number of economies	Number of houses/facilities supplied by SABESP.
Number of connections	Number of connections between the distribution network and consumers' facilities.
Apparent losses	Formerly known as non-physical losses, they are also know as commercial losses; they represent the consumed water portion that was not charged to the consumer (due to: commercial system deficiencies; water meter undermeasurements; illegal connections/unauthorized consumption
Real losses	Formerly known as physical losses, they represent the water losses in water supply system due to leakages in distribution infrastructure and/or reservoir overflows.
Total losses	Difference between the total volume supplied to UNs (integrated system + single system) and the authorized consumption volume.
Branch line	Part of water connection between the distribution network and the rack.
Network rehabilitation	Set of measures aimed to make the distribution network recover its use capacity; any physical intervention extending the distribution network life and involving a change to its condition or specification (IWA).
Infrastructure renewal	Replacement of networks and branch lines under the PROGRAM.

Term	Description
Supply Sector	Area of water distribution network that is confined by watertight and permanent limits and is fed by one or more water inlets.
Sectorization	Interventions in water distribution network aimed to close, through the installation of piping sections and valves, a specific network section, to form a supply sector.
Pipeline system	Set of pipes (pipelines) and special parts (valves, connections and pumps) intended to convey water produced in treatment plants to distribution reservoirs.
Undermeasurement	Volume nor recorded by water meters by virtue of flows lower than the minimum flow for water meter reading accuracy (it is mostly caused by use of water tanks or water meter design inconsistent with the customer's consumption profile)
Network replacement	Replacement of an existing network for a new one with the purpose of restoring or increasing its discharge capacity or repair structural piping problems (fissure; corrosion; etc.)
Average repair time	Average interval between the receipt of requested leakage repair and its exclusion after the completion of service.
Calibration Test	Essay performed in flow meters to keep the measurement system in an adequate accuracy standard.
Emergency Uses	Water consumption during fire training and fight operations and through water tanks for emergency supply.
Special Uses	Authorized non-charged water consumption, including social, operations, emergency and public uses (street wash, draining systems, etc.).
Operational Uses	Water consumption for special operations in the supply system, such as reservoir wash, network disinfection, and sewage network wash.
Social Uses	Consumption in deprived areas (shantytowns, squatted areas and slums
Pressure Reduction Valve	Equipment installed at the entrance of a certain distribution network section with the objective or regulating the pressure in that network section.
Inherent leakage	Non-visible leakage unlikely to be detected by the currently known technology.
Non-visible leakage	Leakage that has not appeared yet and can only be detected by leakage acoustic detection equipment.
Visible leakage	Leakage that is already visible, as reported by the population or Sabesp teams.
Effectively consumed volume	The same as effective consumption = real treated water volume consumed by the customer.
Volume delivered or supplied for distribution	Volume supplied by the pipeline system to UN distribution systems (for reservoirs or direct tapping supply)
Average volume	Consumption volume recorded by water meters
Pressure Zone	Watertight distribution network section with permanent limits and subject to specific pressures from the main supply sources in the sector (reservoir or pipeline), which generally is given the name of Low Zone, High Zone, Middle Zone or zone supplied by direct pipeline tapping (tapping supply).

Notes:

a) Source – Sabesp – Action Plan for Loss Reduction in the Metropolitan Business Unit – Summary and Analyses – (2008 – 2012) – Dec. 2007.

b) Not all terms mentioned above are included in the Interim Report. However, such terms are helpful for a better understanding of several Sabesp reference documents.

Summary

1. Introduction

The State of São Paulo is the most populous Brazilian State accounting for 20% of the country's population. However, its water resources are limited and account for 1.6% of national volume, a fact that makes the efficient exploration and preservation of water resources imperative. Companhia de Saneamento Básico do Estado de São Paulo – Sabesp supplies drinking water to 366 municipalities in the State, which are populated together by 26 million inhabitants (corresponding to 60% of the State's inhabitants), what makes it a world's leading water companies with 17,000 employees (of which approximately 10,000 are engaged in water services) and revenues of 3.2 billion dollars (2008).

However, the water loss rate, which represents the unattended distributed water is as high as 40% and poses as a great challenge to the management. As a result, Sabesp formulated the Corporate Water Loss Reduction Program and since 2004 it has been implementing actions to improve the operational efficiency of water supply system, in particular the minimization of leakages in distribution networks. In spite of such efforts, loss rate recorded in December 2007 was kept at 42%, suggesting that there is space for further improvements.

Under such circumstances, JICA Technical Cooperation Project titled "Water Loss Control Project" (Eficaz Project) is under implementation stage at Sabesp request, over the period of July 2007 through July 2010).

In September 2008, Sabesp prepared the Corporate Water Loss Reduction and Energy Efficiency Program (hereinafter referred to as PROGRAM) covering a period of 11 years, from 2009 to 2019, based on all knowledge acquired hitherto and results from water loss reduction actions.

2. Evolution of Water Loss Rates

Table 2.1 - Water Losses occurred in 1999-2008 period - Sabesp

						(Vp-Vm)/Vp	(Vp-Vf-U)/Vp	(Vp-Vm-U)/(Nx365)
	V_p	V_m	V_f	U	N	IPM	IPF	IPDt
Year	Produced volume	Micro-measured volume	Billed volume	Operational, Emergency and Social Uses	Number of connect-ions	Loss Rate (Micro-measured)	Loss Rate (Billed)	Loss Rate per Connection
	Million m^3	Million m^3	Million m^3	Million m^3	Thousand connections	%	%	l/(conn. x day
1999	2,664.9	1,628.5	1,782.1	66.1	4,715	38.9	30.6	564
2000	2,679.1	1,562.7	1,729.7	109.1	4,977	41.7	31.4	554
2001	2,650.1	1,532.2	1,697.6	119.9	5,085	42.2	31.4	538
2002	2,778.3	1,609.3	1,770.0	127.4	5,228	42.1	31.7	546
2003	2,819.6	1,592.5	1,764.8	125.2	5,364	43.5	33.0	563
2004	2,770.5	1,499.8	1,692.4	135.8	5,667	45.9	34.0	549
2005	2,830.0	1,571.8	1,755.1	157.2	5,798	44.5	32.4	520
2006	2,886.8	1,625.1	1,806.4	160.0	5,908	43.7	31.9	511
2007	2,873.7	1,666.6	1,846.5	178.7	6,028	42.0	29.5	467
2008	2,852.6	1,693.2	1,877.7	183.4	6,168	40.6	27.7	434
Average Growth (1999-2008)	**0.85%**	**0.49%**	**0.66%**	**13.60%**	**3.42%**	**0.55%**	**-1.24%**	**-3.23%**

Source: Table prepared by JICA F/S Mission based on data provided by Sabesp.

IPDt: Index officially adopted by Sabesp under the name of Total Loss Rate; however, the rate used in this PROGRAM is deducted of non-billed water volumes for social uses, called Unattended Water Rate. Unit adopted is Liter/Connection/day.

$$\text{Volume of Loss/Connection/day (IPDt)} = \frac{\text{Vp (Distributed V)} - \text{Vm (Micromeasured V)} - \text{U (Social Use V)}}{\text{Number of connections (N)}}$$

(N)

3. Results and Actions to be implemented during 2004-2008 Water Loss Reduction Activities

With the objective of reducing water losses, Sabesp M and R Divisions planned and implemented over 2004-2008 period the Water Loss Reduction Program, based on actions against leakages and other water losses. This program lists the actions under three major topics: "Leakages", "Losses Other than by Leakages" and "Loss Management". This is a program under which different conceivable actions are intended to be implanted, which could be called "Trawling Operation (arrastão)".

As a conclusion of analysis of M Water Loss Reduction Plan results in 2004-2008, the following themes were mentioned:

(1) Sufficient investment of funds

We could say that funds invested in the Water Loss Reduction Plan (2004-2008) prevented the natural increase of unattended water volume. However, they were not sufficient to reduce substantially that volume.

(2) Continuous efforts

The importance of maintaining continuous actions focused on loss control has shown goods results at our evaluation of regions (systems) that succeeded in that activity. The continuity of such actions will certainly improve the structural conditions, both in terms of diagnosis and control of unattended water volume in such regions.

(3) Efficient water loss reduction and monitoring plan

To achieve the best results and minimize costs, the importance and scope of activities should be considered and planned on the basis of standards, such as the assurance of funds to allow unattended water volume to be reduced. It should make clear the progress of funds allocated to the program, evaluation of cost-benefit, etc. During PDCA cycle, the plan needs to be reviewed in a yearly basis.

(4) Introduction of new techniques.

Introduction of new techniques and improvement of activities and control. If the technical progress is included in PDCA planning stage, the best results will be obtained (for example, use of polyethylene pipes with welded seams).

(5) Analysis of causes of unattended water volume

Investigation and elimination of the original cause of leakage and unattended waters other than leakage waters. For example, supply infrastructure in many M systems (piping networks) is in poor conditions and requires urgent renewal of water distribution networks.

(6) Standardization of quantitative criteria for indicators and figures.

It is necessary to standardize specific indicators and consumptions related to water loss in M and R and in each Business Unit.

(7) Capacity strengthening

Topics would include: quality of material, improved staff skills, and method adequacy. Training is important to strengthen Sabesp and private sector employees' technical skills with respect to the PROGRAM. In particular for network and branch line replacement works, that aspect should be considered.

(8) DMC Installation

The accurate analysis of water distribution status will better allow the application of investment in activities to be focused on water loss reduction. Dividing the distribution network into areas called Measurement and Control Districts – DMC is an emergency matter.

A better form to control losses in water distribution networks can be obtained by subdividing the

supply sectors, by attaching the information contained in database (number of connections, type of network, leakage mapping, etc.) together with the confirmed geographic position (for example, using SIGNOS). The size of areas varies from the minimum of 500 connections to the maximum of 3,000, which is the limit to determine the flow changes in occurrences of water leakage volume. In particular, when the infrastructure is of poor quality, the smaller the area the greater is the possibility of water leakage control.

(9) Construction of Water Loss Information Control System

Data from results of actions against water loss, accumulated in such tools as the Service Management System – SIGAO (database used for metropolitan area system control), are indispensable for water loss control. Currently, information control is not perfect, and the topics focused on the following stages include:

- Recording in database all materials, elapsed years, etc. related to the program.
- Investigation and record of data on events occurred in 2002-2006, such as water leakages, water quality pollution, water pressure reduction, etc.
- Analysis of recorded data and organization of number of occurrences of problems.
- Selection of the region of concentration of occurrences of problems as a target-area.
- Investigations and evaluation of areas adjacent to the target area by the technical department of each Business Unit.
- Indication in the map of each Business Unit of problems in the target area, such as, for example, problems in the water distribution network.
- At Metropolitan Division, by using the data indicated in thematic maps as a standard, the most significant problems are identified, except the relevant actions focused on the elimination of such problems.
- Follow-up of the project progress, periodical renewal of information with new diagnoses, and selection of target area

4. Analysis of the "Corporate Water Loss Reduction and Energy Efficiency Program"

This PROGRAM, also known as "Corporate Loss Program" integrates into a single program the water loss reduction activities planned by each Business Unit.

The PROGRAM, through an improved water loss rates and by exploring efficiently the limited water resources, will be able to mitigate the overload on the environment and at the same time contribute to reduce investments in facilities to meet future water demands, to the company's improved profitability and stable water supply in urban areas. The Corporate Water Loss

Reduction and Energy Efficiency Program was approved by COFIEX (Foreign Financing Commission of the Ministry of Planning Budget and Management) on 04/24/2009. COFIEX is constituted of representatives of the Ministry of Finance and Ministry of Planning, Budget and Management, to make the technical evaluation of project, discuss their validity and make qualification. In parallel, this project obtained on 03/30/2009 the approval of the Legislative Assembly of the State of São Paulo for JICA financing.

5. Project Guidelines for the "Corporate Water Loss Reduction and Energy Efficiency Program" (PROGRAM)

Sabesp prepared 22 project components for water loss reduction action. Among more than 502 Sabesp supply systems, 158 systems have been selected as "Priority Systems" for the execution of four more costly actions as listed below:

a) Renewal of water distribution networks;
b) Installation of pressure reduction valves;
c) Sectorization;
d) Installation of Boosters.

Such 158 priority systems that represent the highest losses per water connection (IPDt) will be applied all 22 PROGRAM components. In the remaining 344 non-priority systems 18 components will be executed, excluding the four components listed above.

We provide here an explanation of the term "priority". As Sabesp has only a brief history of water loss reduction activities, the effect of each project component is not well established, nor the status of each Business Unit. Such components are different and will result in different priority for Business Units. JICA F/S Mission has concluded that the definition of priority established by Sabesp is feasible, according to the PROGRAM process progress.

6. Contents of project components for the PROGRAM

They are divided into categories:

(A) action against total water loss volume;
(B) action against apparent water loss volume;
(C) water losses, leakage control, management;
(D) Energy Efficiency Program.

A-1 Network and branch line replacement

Durability of networks and branch lines will depend on the quality of material and quality of work execution. Branch lines currently implanted are of good quality. Under the PROGRAM, upon the occurrence of branch line leakages, they will be replaced for new branch lines rather than repaired. On the other hand, network lifespan is estimated in 50 years. Under the PROGRAM, because of financial restriction, the criterion of giving priority to poor-conditions areas has been adopted, and 1.1% of network system is intended to be replaced per year. Network replacement includes related branch-line replacement.

A2 Non-Visible Leakage Survey

Seventy-five (75%) of network system will be surveyed. The planned extension of non-visible leakage survey will be the total cyclic surveys performed in the network, To obtain even greater effects, leakage detectors (earphone-type, correlation and others) will be used, ABENDI qualification will be required from service providers, and surveys will be standardized by field operational criteria and preparation of manuals and previous training in survey practice through capacity building courses. Leakage survey will also be made frequently in repaired or replaced piping, to confirm the efficacy of actions and eventual recurrences.

A3 Replacement of networks

These include repairs in networks with visible and non-visible leakages. Such activities have been performed by UNs, but they will now be performed aiming, in addition to repair time reduction, repair service standardization, work quality improvement and structural improvement of branch lines and respective material. Network repair will follow branch line replacement.

A 4 Sectorization, Installation of VRPs, DMCs and Slum Area Delimitation

Sectorization aims to reduce losses by improving the pressure control. This action will allow the pressure adjustment to be controlled to a level that will not impair water supply. Pressure Reduction Valves (VRPs) and Boosters will be installed to optimize operations.

Unified sectorization criteria have been established taking into account the characteristics and quantities informed by UNs.

DMCs will be basically implanted to measure those data that directly impacts the operational management of water supply system, in areas with less than 2,000 connections.

Slum area delimitation aims to identify the volume supplied to slums. Under the PROGRAM, there will be 5 areas where implantation will be experimental.

A 5 Acquisition of Equipment and Loss Control

This includes equipment for water distribution measurement and leakage detection: hearing rod, electronic geophone, portable micrometer, datalogger, metallic mass plotter, non-metallic mass plotter,

control of Pressure Reduction Valve, VRPs, etc.

B 1 Water Meter Replacement

Over the time, water meter errors increase. Water meter rehabilitation may be divided in 3 cases: corrective replacement, preventive replacement and adequacy.

For preventive replacement of low-capacity water meters, frequency has been established in 8 years, and it is scheduled to replace 1/8 every year or a corrective replacement, as necessary. High-capacity water meter replacement periodicity will be 3 years, and it is scheduled to replace 1/3 every year, in addition to corrective replacement (maintenance) of 10%.

B2 Action against Irregular Connections: Illegal Connections; Inspection of Inactive Connections; Connection in regularized slums; Installation of built-in measurement board (UMA)

We understand than taking no action against illegal connections (water theft) by users means encouraging illegal acts. Illegal connections (water theft) should be treated severely and continuously. PROGRAM actions include actions against illegal connections (water theft) and inspection of inactive connections. Through activities performed so far, 0.5% – 3.5% of total connections have already been inspected. It is reported the identification of any kind of irregularity in some 20% of inspected connections. For such cases, the PROGRAM provided for the installation of a new measurement device called UMA, which will be also installed in new connections requested.

Inspection of inactive connections consists of checking the connections where supply appears as inactive in the customers' database, by virtue of dweller's move or other reasons. The PROGRAM provides for the inspection of all inactive connections.

Slum regularization is the responsibility of the municipality. It rests with Sabesp to make connection in regularized slums.

B 3 Update of Customer Records:

Update of customer records is a basic activity. That update aims to confirm the real estate nature, which may be recorded as residential and then changed to commercial or condominium. The program provides for the survey in all cases.

C1 Installation and Adequacy of Macrometers:

Installation and/or adequacy of flow measurement equipment with the objective of identify volumes produced, transferred and delivered to Business Units.

C2 Macrometer Calibration:

Periodic calibration of flow macrometers determines the reliability of volumes obtained. Sabesp has a methodology developed jointly with the Technological Research Institute of the State of São Paulo – IPT for field micrometer calibration, which will be applied to the implementation of this action.

C3 Capacity Building:

Its objective is to improve the quality of branch line replacement works. The activity aims to standardize the work procedures, establish the training system, and improve the technical skills of Sabesp employees. In addition, service providers will also be involved to participate in training sessions thus meeting the certification requirement, similar to the application adopted by Sabesp for companies that provide leakage survey services.

C4 Socioeducative Actions:

These are activities aimed to make the population aware of water loss reduction.

C5 Management Consulting Costs

Action aimed to consultant agreements for PROGRAM implementation management.

D Energy Efficiency Program:

Main scheduled energy efficiency activities: System optimization (review for network adequacy, sectorization of supply zones through VRP installation); Optimization of facility operation (efficient operation of pumps and motors); Optimization of operational system (automation, operational optimization in low-demand hours).

The PROGRAM aims to save energy in water supply system by means of such activities.

7. Change to PROGRAM

Originally, the PROGRAM provided for the implementation in 4 stages. 1st Stage (2 years, 2009-2010) financed by Banco Nacional de Desenvolvimento Econômico e Social – BNDES, and the 2nd Stage (3 years, 2011-2013) financed by Yens requested to the Japanese government.

However, BNDES funds for the 1st stage have become difficult in light of the financial crisis escalation. As a result, the following changes have been proposed by Sabesp: to give the original 1st Stage the name of "Transition Stage" where preparatory activities will be implemented; postpone the actual start of works to 2011; and allocate the Yen loan to the stage starting in 2011, which will become the "new "1st Stage. According to Sabesp, the volume of loss fight actions scheduled for 2009-2010 period will be smaller, and the remaining actions will be financed by its own funds (and a possible financing).

Time and amount of financing for the PROGRAM during JICA Stage (2011-2013) will not be changed.

JICA Stage means the period of 3 years (2011-2013) when Yen-financed projects will be executed.

The adjusted PROGRAM was delivered by Business Units on May 25, 2009. It should be pointed out that this interim feasibility study report analyzes the corporate program as a whole, not each Business Unit program individually. UN programs shall be subject to a more accurate analysis at the preliminary project stage.

Another change proposed by Sabesp was the exclusion of electric power generation plants, 2 PCHs in Cantareira System and 1 biogas-powered PCT in Barueri ETE, the execution of which would be financed by JICA, but will be executed earlier with Sabesp own funds. Therefore, such works will be excluded from the original group of components. Regarding energy saving in existing pumping stations, studies and projects will be financed by Sabesp funds, but the works will remain as components of JICA stage, according to the original request.

Changes referred to above were agreed by JICA Monitoring Mission of May 13-28, 2009.

8. PROGRAM Evaluation

Five aspects of Program have been evaluated (11-year project): Importance, Efficacy, Efficiency, Impact and Sustainability. The Program was considered feasible.

(1) Importance: For reasons stated below, JICA Stage can be considered of high importance as a Yen-financed project.

- Utmost objective: The objective of this project is in line with Brazilian and São Paulo State development policies.

  The population of the State of São Paulo amounts to 40 million inhabitants, which account for 20% of the Brazilian population. Supplying water to this increasing population is becoming a serious problem. To make the situation worse, exploring new water sources has proved difficult because of the respective environmental problems and unavailability of good sources in the proximities of São Paulo Metropolitan Region. As such, it is important to minimize leakages in Sabesp networks that serve 26 million inhabitants in the State of São Paulo, and increase the operational management capacity in water supply facilities to open perspectives for the efficient use and preservation of limited water resources in the State of São Paulo.

- Compatibility with priority topics of Japanese assistance and JICA country assistance program.

  Japanese ODA medium-term policy establishes the development of human resources and support to knowledge and actions at global environmental level (environmental preservation, among others) as priority matters. Environment sector is a basic topic of Japanese diplomacy. In addition, the Country Project Implementation Program (2002) establishes as priority areas the regional promotion and

social development for environmental preservation and inequality correction. Moreover, in JICA Topic Guidelines (preservation of natural environments), the increase of natural resource management capacity by local community and preservation of high-biodiversity regions and ecosystems are considered priority issues. The objective of the Corporate Water Loss Program, i.e., the efficient use and preservation of water resources, is included in priority areas and items referred to above.

- The following basic guidelines are mentioned in JICA Country Project Implementation Program (2002).

  Basic guidelines have been established in this program based on the following assumptions:

  (1) Several levels of cooperation and interchanges between those that implement diverse developments, especially the private sector, will result in closer bilateral economic relationship and gains for both countries (benefit for both countries).
  (2) Eliminating poverty and inequalities is a major challenge in Brazil. In health sector, medical care and other objective actions have been adopted in the country. Japan has also learnt cooperation lessons from those sectors involved with the population and has, in turn, tried to transmit the idea of valorizing justice. If such initiatives could be disclosed in and out of the country as model programs based on values shared by both countries, this would result in joint international contribution of both countries (benefit for both countries, international benefit).
  (3) Global issues, such as environmental preservation, food production and other are important issues that the international community should tackle for their great importance for their whole mankind (international benefit.
  (4) Transfer and diffusion of cooperation results to Portuguese and Spanish speaking countries could have even greater effects (international benefit.

- Alignment with other projects (assistance by Japan and other donors).

  With respect to Japanese assistance, the Technical Cooperation Project for Losses (EFICAZ Project) is in line with the objectives of the Corporate Water Loss Program. Inheriting and developing the results of EFICAZ Project may bring synergy. Promoting the integration of financing cooperation and technical cooperation is in line with Japanese ODA policy.

  With respect to assistance by other donors, there are in the State of São Paulo other projects financed by the World Bank, IDB, and other institutions. The Corporate Water Loss Program is also in line with projects of other donors.

- High priority in Sabesp administrative policy

  The Corporate Water Loss Program occupies an outstanding position in Sabesp long-term plan.

- Japanese technology

Japanese technology evidenced in EFICAZ Project has been well evaluated. Technical knowledge transferred by that project has been used in several parts of the process of preparation of the Corporate Water Loss Program. It is concluded that Yen loan is highly important for the Corporate Program in terms of loss management, for which Japan has a more advanced technology.

(2) Efficacy:

- Target of JICA Stage is "to increase Sabesp capacity in terms of water loss management." Indicators of target achievement level are shown below, Both target and indicators at this stage are clear and adequate.

  1) Water Loss Rate in 2019.

  2) The Water Loss Rate per connection in 2019.

- Internal Financial Rate of Return is 5.33%.

(3) Efficiency: JICA Stage may achieve an efficient implementation for the following reasons:

- Individual plans to meet JICA Stage targets have been proposed according to the operational reality of each UN.
- During 2009-2010 preparation period, the water loss information management system will be established, which will provide the head office with a structure that will make the operational management of JICA Stage implementation easier.
- In addition to expected EFICAZ projects results in connection with technical and management staff capacity building, the manager is at contracting stage. Given the fact that JICA Stage implementation is likely to provide Sabesp with a sustainable water supply operation by acquiring the ability to identify the water loss causes and analyze and implement effective actions, JICA Stage may be considered adequate and efficient.

(4) Impact: JICA Stage impact may be considered as follows:

- Water loss is an important managerial issue. The Corporate Water Loss Program will take 11 years to solve this problem. The scope of participation of this Corporate Program in the investment plan will allow the size of Program impact on Sabesp management as a whole to be recognized. This Program should also be considered as part of management efficiency process. Program impact on Sabesp business sustainability will not be small.
- Synergy with EFICAZ Project results is expected with respect to losses.
- JICA Stage, which corresponds to the 1st Corporate Program Stage, is expected to exert great impacts in the following stages.
- Actions against illegal connections in slums will have social impacts.

(5) Sustainability: There are not great problems with respect to the perspective of JICA Stage autonomy and sustainability

- Sabesp is a great organization that employs some 17,000 employees. Implementation structure is constituted of skilled staff.
- Sabesp is a corporation listed in São Paulo and New York Stock Exchange. Its management is stable and its foreign borrowing is a stable source of funds. Investments in new businesses are supported by Sabesp. It is anticipated that, after the Yen-financed stage, funds to maintain the operational management will be assured, and the implementation of loss control activities will continue.

Water loss control had been given Sabesp attention, but the effective start of actions supported by Sabesp own funds took place in 2004. Based on results of completed activities, high-value investments have been allocated to the Corporate Water Loss Program. However, loss control means to manage water supply in an integrated manner, and the related actions will not cease after the Corporate Program completion. Maintenance and management actions should be permanent. As such, a long-term maintenance plan should be set up to include the activities that will follow the Program completion; That plan should include, without limitation, the creation and implementation of periodic patrols to detect leakages; planned rehabilitation of piping according to network age; scheduled replacement of water meters every 8 years. In addition, the Corporate Program implementation should also include activities focused on maintaining and expanding the effects after the Program completion. That includes activities to acquire know-how and learn procedures throughout the Program, with the objective of supporting the conduction of a series of matters, such as: determination of Sabesp parameters; adoption of materials consistent with their use; adoption of techniques consistent with local characteristics; storage of data on recovered networks and branch lines; enhancement of leakage detection techniques; improvement of work execution methodology; training in work execution techniques for contractors; training in work inspection for Sabesp staff; and others.

9. Transition Stage Activities (2009-2010)

(1) Implantation of Loss Management System - SGP

An issue of Sabesp water loss reduction activities is the insufficient "Basic Actions". Sabesp is provided with a great volume of information in its database, which are useful for loss control actions, but handling that information has some practicability problem. In other words, mapping (network diagram), distributed volume and micromeasured volume are not organized per distribution sectors; Data on leakage occurrences and customers' complaints are not linked to water loss control actions (data organization has been improving); there are some constraints to retrieve from the database information on piping (type, diameter, year of installation, length); difficulty to plot the maps necessary for actions against Water Loss by Loss Management System – SGP.

10. Transition Stage Activities (2009-2010)

(1) Enhancement of work inspection techniques

Improvement of work execution methodology and work inspection techniques by Sabesp employees and Eficaz Project with the following targets: qualification of human resources and loss management technology transfer through courses and OJT (On-the-Job Training). Eficaz Project is not limited only to training in work execution and inspection methodology. Based on the assumption that loss control is a synonym of integrated water supply management, Eficaz Project aims to disseminate in all UNs the tools and know-how related to water loss control. Business Units have submitted their desired action plans for water loss control, and the PROGRAM is the consolidation of such actions into a long-term plan. Later, over the 2-year transition stage, UNs will use the know-how obtained from Eficaz Project to validate the criteria for selection of priority actions, methodologies for selection of network rehabilitation sites and local conditions; as well as the preparation of action plans, which will be the next steps, combined with the importance of having continuous maintenance and management actions in place, and with the results obtained from water loss reduction actions.

11. Feasibility Study for JICA Period

The "Corporate Water Loss Reduction and Energy Efficiency Program", hereinafter referred to as PROGRAM, is an 11-year plan (2009-2019) where the period of 2011-2013 comprises the Application for Yen (¥) Loan to JICA, hereinafter referred to as JICA Stage. The PROGRAM general concepts were based on results of activities already completed. This Feasibility Study analyzes the PROGRAM by taking such concepts into consideration.

F/S Mission visited all 15 Sabesp Business Units, investigated the scheduled actions and target area, and evaluated the need, efficacy and adequacy of priorities of planned actions.

12. Preliminary Project Guidelines for JICA Stage

The formulation of the PROGRAM was based on Sabesp Technical Standards – NTS, Procedure for Service Execution, and Technical Manual already available at Sabesp.

The method of work adopted by the Feasibility Study Mission, hereinafter referred to as F/S Mission, was based on the understanding or Sabesp guidelines and methodology study, rather than the imposition of new guidelines. The conclusion of this work suggests that F/S Mission and Sabesp share the same understanding on the matter.

13. Situation of Water Losses in each Business Unit

IPDt Variation in each Business Unit (l/connection/day)

UN.	2004	2005	2006	2007	2008	2009
MC	618	558	548	498	430	402
ML	580	540	555	464	393	372
MN	527	498	508	461	441	406
MO	576	489	453	454	459	434
MS	699	634	634	582	529	484
Total M Division	**601**	**546**	**543**	**493**	**451**	**420**
RA	280	270	275	258	251	239
RB	236	234	221	210	182	174
RG	202	204	199	186	176	172
RJ	444	450	462	424	398	385
RM	411	413	406	416	394	384
RN	481	483	449	393	375	376
RR	218	219	221	199	174	175
RS	621	629	566	566	517	509
RT	127	135	129	124	119	118
RV	420	389	390	373	345	325
Total R Division	**369**	**366**	**351**	**338**	**314**	**305**
Total Sabesp	**547**	**523**	**511**	**468**	**433**	**417**

14. Characteristics and Main Problems in M Business Units

São Paulo Metropolitan Region houses all Business Units reporting to M Division (M), where water supply system is old, there is a busy traffic of vehicles in some cities, there is a relatively great number of slums and a far-reaching population of a typically abnormal size, and there are generally very similar problems that mostly include:

- Most of leakages occurring in branch lines;
- Advanced age of distribution networks;
- Water shortage in critical points;
- Poor quality of material used in branch lines (black PEAD and zinced iron);
- Deficient pressure control;
- Direct tapping;
- Irregular areas.

15. Characteristics and Main Problems in R Business Units

R systems are located in the hinterland and cost of the State of São Paulo, where most of municipalities are considered small. There are municipalities with large demographic concentrations, where problems are similar to those in SPMR, although regionalized.

16. Loss Reduction Program for Business Units (JICA Stage)

Based on the current status of losses and problems, all 15 Business Units and the Water Production

Unit (MA) have prepared their own action plan and designed their own project for JICA Stage, according to "Preliminary Project and Order of Priority Criteria". The Feasibility Study Group visited all Business Units to review the plan preparation stages, and concluded that it is adequate according to the situation of each Unit.

Calculation base and quantities of main PROGRAM components

Components	Unit	Calculation Base for Quantity
A1.1 Branch Line Replacement		
Corrective replacement	connection	Applied to 15 Units from MC ~RV. 35%-95% of leakages occur.
Preventive replacement	connection	Only MC and RN reserve funds for preventive replacement, in addition to corrective replacement 1.7% (RN) and 4.3% (MC) of branch line connections were calculated.
A1.2 Network replacement	km	0.55%-1.33% of network length or priority network length.
Branch line replacement	connection	Number of network connections x length of replaced network
A1.3 Repair for leakage survey (branch line replacement)	connection	Number of detected leakages x 0.7-1.1 site/km x 80%-95% MC only: 35%
A2 Leakage Survey	km	75% of network length RT only: 65%
A3.2 Repair of non-visible leakage (networks)	unit.	Number of detected leakages x 0.7-1.1 site/km x 5.0%-20%
B1.1 Replacement of high-capacity water meter	unit.	Number of water meters x 1/3 x 1.1
B1.2 Replacement of low-capacity water meter	unit.	Number of water meters x 1/8 x 1.1
B2.2 Irregularity Survey	unit.	Number of connections x 0.35%-3.5%
UMA installation	unit.	Detected number of irregular connection x 4%-30%
B.3 Update of Records	unit.	Number of active connections x 5%-20%

Quantities of remaining Program components will be established according to regional characteristics and each Business Unit priorities.

17. Preliminary Maps

The Feasibility Study Group used AutoCad to plot the preliminary maps, based on information provided by each Business Unit. The reduction scale is 1/10,000. Maps include the location of networks to be replaced, sites where VRP, Boosters, macrometers are scheduled to be installed, and sectorization implantation. Such maps are attached as part of bidding documents.

18. Cost Estimate for JICA Stage

In September 2008, the cost of PROGRAM (2009-2019) was estimated, and in May 2009, because of partial change to quantities, the PROGRAM cost was recalculated. PROGRAM cost estimate was based on Sabesp price database of October 2007. Sabesp division in charge of budgets TEV – Project Evaluation Department, which is provided with 25 employees and is responsible for setting the price of inputs comprising the cost of works. That department to the Division of Technology, Projects and Environment, and has set, through a 10-year experience in procurements, the unit prices of works to a

high reliability level. As such, for the PROGRAM cost estimate, the unit price of works was adopted based on Sabesp standard unit price prevailing in October 2007, applicable to all 15 Business Units and the Water Production Unit.

Sabesp reference unit price were calculated by their classification into material cost and labor cost. According to the differences of PROGRAM implantation sites, we could find some difference at determining the unit prices:

1. MA	Equipment installed in area controlled by MA is large, as it comprises structures for water pipelines of large diameters. PROGRAM components estimated for MA include: performance of non-visible leakage survey in pipelines, installation/adequacy and calibration of macrometers.
2. Metropolitan Division - M (Excluding MA)	Located in urban areas, it is influenced by the heavy traffic of vehicles, which brings restrictions to some works. (branch lines will be replaced by non-destructive method).
3. Regional System Division - R	Located in the State inland, it does not have great restriction for work implantation (all executed by destructive method). Rate of work execution on sidewalks is higher than M rate.

The Feasibility Study Group determined that the estimates calculated by each Business Unit are feasible.

Estimated Cost of JICA Stage per Business Unit (R$ 1,000)

UN	2011	2012	2013	Total	(%)
MA	3,507	3,518	4,685	11,710	1.1
MC	41,223	41,862	40,274	123,358	11.9
ML	51,164	41,526	49,629	142,319	13.7
MN	40,196	42,794	40,699	123,689	11.9
MO	37,024	37,388	37,755	112,167	10.8
MS	59,523	56,523	42,540	158,586	15.3
TOTAL M	**232,637**	**223,611**	**215,581**	**671,829**	**64.7**
RA	11,866	11,111	10,376	33,353	3.2
RB	10,252	9,413	8,790	28,455	2.7
RG	7,371	7,762	7,794	22,927	2.2
RJ	11,118	8,331	7,770	27,220	2.6
RM	12,215	12,079	12,342	36,635	3.5
RN	4,799	4,526	4,870	14,195	1.4
RR	3,675	3,650	3,498	10,823	1.0
RS	37,402	41,336	17,722	96,461	9.3
RT	4,884	4,996	4,753	14,633	1.4
RV	16,636	17,300	17,258	51,193	4.9
TOTAL R	**120,217**	**120,505**	**95,172**	**335,894**	**32.4**
TOTAL T	**10,000**	**10,000**	**10,000**	**30,000**	**2.9**
Total Sabesp	**362,853**	**354,116**	**320,753**	**1,037,722**	**100.0**
TOTAL Energy Efficiency	**15,000**	**14,000**	-	**29,000**	
TOTAL JICA Stage	**377,853**	**368,116**	**320,753**	**1,066,722**	

19. Cost of project per Program components

The Table below shows price compositions during JICA Stage, being: A-70% Real loss control actions; B – 22% Apparent loss control actions; and C – 6% Management and control of losses and leakages.

Cost of JICA Stage per Action (R$ 1,000)

No.	Action	2011	2012	2013	TOTAL	%
A1-1	Branch line replacement	78,020	77,197	76,320	231,538	22.3
A1-2	Networks and branch line replacement	54,797	58,832	62,244	175,873	16.9
A1-3	Branch Line Replacement – Leakage Survey	7,134	7,134	7,134	21,401	2.1
A 1	Total Infrastructure renewal	139,951	143,163	145,697	428,812	41.3
A-2	Leakage Survey	9,580	9,580	9,580	28,740	2.8
A-3-1	Visible Leakage Repair in Network	23,319	23,086	22,855	69,260	6.7
A-3-2	Non-Visible Leakage Repair (Network)	2,298	2,298	2,298	6,893	0.7
A3	Total Repair	25,617	25,384	25,153	76,153	7.3
A-4-1	Sectorization (Implantation of Pressure Zones)	60,861	59,302	26,726	146,889	14.2
A-4-2	VRP	7,846	4,765	4,620	17,231	1.7
A-4-3	DMC	8,407	7,546	7,085	23,039	2.2
A-4-4	Booster	5,193	2,048	869	8,109	0.8
A-4-5	Slum Closing	770	720	0	1,490	0.1
A 4	Total Sectorization	83,077	74,380	39,300	196,758	19.0
A 5	Equipment	5,583	4,285	3,426	13,294	1.3
A	**Total Real Loss**	**263,808**	**256,792**	**223,157**	**743,757**	**71.7**
B 1.1	Replacement of High-Capacity Water Meters	3,168	3,076	3,076	9,320	0.9
B 1.2	Replacement of Low-Capacity Water Meters	45,053	45,053	45,053	135,160	13.0
B 1	Total Replacement of Water Meters	48,222	48,129	48,129	144,480	13.9
B 2.1	Inactive inspections	6,622	6,622	6,622	19,865	1.9
B 2.2	Irregularity Control - Inspection	4,857	4,841	4,857	14,555	1.4
B 2.2	UMA Installation	8,198	8,198	8,199	24,595	1.1
B 2.3	Slum regularization	7,027	7,027	7,118	21,172	2.4
B 2	Total Irregularity Control	18,506	18,489	18,596	55,591	2.0
B 3	Record Update	3,634	3,634	3,634	10,903	7.7
B	**Total Apparent Losses**	**78,560**	**78,451**	**78,558**	**235,569**	**22.7**
C1	Installation / Adequacy of Macrometers	5,990	4,547	4,608	15,145	1.5
C2	Macrometer Calibration	2,550	2,554	2,558	7,661	0.7
C3	Capacity Building	718	545	645	1,909	0.2
C4	Socioeducative Actions	1,227	1,227	1,227	3,682	0.4
C5	Demand from Technology and Environment Division (Management)	10,000	10,000	10,000	30,000	2.9
C	**Total Management**	**20,485**	**18,873**	**19,038**	**58,397**	**5.6**
	Total Losses	**362,853**	**354,116**	**320,753**	**1,037,722**	**100.0**
D	**Energy Efficiency**	**15,000**	**14,000**	**0**	**29,000**	
	Grand Total	**377,853**	**368,116**	**320,753**	**1,066,722**	

20. Energy Optimization Program

After energy efficiency studies in 7 sites proposed by Sabesp, it was concluded that, except for warehouse and Rio Grande Water Pumping Station, optimization is valid in all other sites and should be implemented.

Such studies have a limited target, but in Sabesp there is a high use of electricity in pumping areas (approximately 5,000 municipalities, 11 of which are supplied with 88-kV low voltage power, some 1,000 municipalities are supplied with 13.8-kV medium voltage power, and all others are supplied with 220-V power by concessionaires. Therefore, there are several locations with possibilities of optimization similar to Vila Medeiros Water Pumping Station and São José *Booster Pump* Station.

Therefore, the result of implantation of Electric Power Optimization Program will be useful for future plans of many facilities.

21. Material and equipment supply/purchase methods

In general, 2 purchase procedures are followed by SABESP:

(1) Shopping

Material and equipment, such as polyethylene pipes, cast iron pipes, water meters, etc. acquired under procurements, are supplied by several companies, given the difficulty of a single supplier to meet the required demand on schedule and at the unit price specified in the bidding documents over the period of 1 year.

To purchase those materials, Sabesp adopts the Shopping procurement method, which is a special procurement method provided in federal laws 8,666/93, as amended, and 10,520/02, the objective of which is to quote the prices of consumption goods selected by electronic bidding for future contracts.

The Superintendence for Supply and Strategic Contracts (CS) shall coordinate and carry out the bidding process using the method referred to above, including the preparation of bidding documents, conduction of bidding, selection of suppliers, contracting and quality inspection.

(2) Usual Supply/Purchase Methods

For low-demand material, such as pressure reducing valves and booster pumps, orders are sent to suppliers quoting the lowest price in the bidding process.

With respect to Booster pump supply/purchase, the relevant Business Unit may carry out the respective bidding process.

Sabesp classifies the bidding process into 4 categories, according to the purchase price:

Bidding Process	Construction Work	Materials and Services	Notes
A. Waived	Less than R$ 30,000.00	Less than R$ 16,000.00	Bidding is usually waived.
B. Invitation	Less than R$ 150,000.00	Less than R$ 80,000.00	
C. Shopping	Less than R$ 1,500,000.00	Less than R$ 650,000.00	
D. Competitive Bidding	More than R$ 1,500,000.00	More than R$ 650,000.00	International Competitive Bidding, if applicable

In case of bidding, at least three (3) firms must participate, according to Law 8666/93, which governs procurement processes in Brazil There is also an internal restriction by Sabesp, which establishes that each Business Unit may only carry out a bidding process until Class C.

According to the study above, the Feasibility Study Group concluded that it is feasible to follow Sabesp current method of supply of material and equipment during JICA Stage.

22. Work Execution Plan

Techniques for execution of most significant PROGRAM components have been considered, such as:

(1) piping replacement works;

(2) branch line replacement works;

(3) pressure management components (sectorization, Booster installation, VRP/DMC installation);

(4) water meter replacement.

Basically, there are no problems. Like the water flow test, pressure and leakage test are also required. It is being tried, deliberated and determined in pilot-area of Eficaz Project, to establish the standard procedure.

For water loss reduction activities formally started in 2004, many companies provide outsourced services: from piping renewal and rehabilitation works to survey of non-visible leakages, water distribution control, water meter installation, inspection and replacement services, etc.

Actions included in JICA Stage will focus predominantly on works to be controlled by Sabesp. Companies qualified to execute the works, both in São Paulo Metropolitan Region and in inland and coastal areas of the State of São Paulo, have been listed and evaluated by this JICA Mission (see Annexes).

23. Organizational Framework

Because the existence of several Business Units, it is desirable that a Project Management Unit be established: PMU ((hereinafter referred to as PMU or UGP).

UGP shall be responsible for the PROGRAM implementation and shall be the only liaison between Sabesp and JICA for matters related to this PROGRAM and the Loan Agreement to be signed. Sabesp intends that UGP be a structure within the Superintendence for Operational Development - TO.

UGP shall be responsible for:

- Development of Standard Bidding Documents for contracts;
- Budget control;
- Follow-up of progress of Contracts and schedule control;
- Request for JICA approval of all related documentation.

The management consultant will support UGP for the management and control of progress of works and management of funds in each Business Unit.

With respect to execution of project in each Business Unit, that is, contract management, execution of works and effects of water loss reduction, each Business Unit will take over its control.

For this PROGRAM, taking into account that many agreements will be entered into, the most

recommendable forms of payment for Sabesp will be through Special Account.

Sabesp will review and standardize the procedures for execution of services and works and implant SGP – Loss Management System, which will support the follow-up of loss control actions and result management.

24. Inspection

The greatest concern at JICA Stage is how to execute works without decreasing the quality, and the possibility of efficient inspection by Sabesp employees. Sabesp is preparing a staff qualification framework jointly with Eficaz Project.

25. Organizational Operation and Maintenance Framework

There are some differences between the Metropolitan Division and Regional System Division in relation to volume and size of projects, due to regional characteristics of each Business Units, which cause several levels of difficulties for their management; however, all UNs will require technical maintenance and basic control skills. The Feasibility Study Group suggested that the 4 items below should be followed for operational framework maintenance:

(1) Enhancement of Basic Distribution Network Actions (water pressure, water quality, information on water volume, organization and improvement of distribution network information).
(2) Operational Management System (improvement of professionals' skills).
(3) Basic Piping Network Information System – SIGNOS.
(4) Procedures for Project Evaluation and Operations (setting up of procedures that would enable evaluation even by maintenance units).

26. Preliminary Environmental Studies

We present initially the conclusion that, in piped water area of the State of São Paulo, projects for Water Treatment Plant, water distribution and reservoir will require an EIA and environmental license. With respect to work/project for residential water distribution (networks and branch lines), which is the main component of this project, it is classified by a Resolution of the Secretariat for the Environment of the State of São Paulo as a work/project that does not require an environmental license. Therefore, for JICA Stage project components, EIA and environmental license shall not be required.

Taking into consideration the results of screening work, according to old JBIC guidelines on environmental concerns, results of environmental assessment, the environmental law in Brazil, and the Brazilian environmental management system, it can be concluded that the components of this Program will most unlikely cause serious impacts to the physical environment or to the social environment. In terms of classification referred to above, this Program may be classified as Category B.

27. Program Implementation Schedule

It can be clearly noted that it is extremely difficult that said schedule is implemented in the beginning of 2011. Sabesp emphatically requested to the F/S Evaluation Mission (October 2009) that the visit of JICA Approval Mission would occur only in the beginning of 2010, especially for issuance of "Pledge" as soon as possible, to allow the procedures required for the following stage to speed up; Exchange of Notes (E/N), approval by the Brazilian Senate (Congress), and signing of the Loan Agreement (L/A).. Also, with the "Pledge", it will be possible to speed up the selection of Management Consultant and the companies that will participate in the PROGRAM.

Because 2010 is an election year in Brazil, several factors are expected to administratively influence the loan approval by Brazilian authorities. Should the execution of JICA Stage works really start in the beginning of 2011, it is necessary a better evaluation and prior confirmation of implementation of current schedule between JICA and Sabesp.

28. Borrowing Plan

To raise funds for the project, Sabesp requested a loan of 85% of total loan cost, in addition to its counterpart funds of 15%. The requested loan amount is approximately Yen 48 billion (exchange rate: US$ 1.00 = R$ 1.85 = ¥ 100, October 2008, according to COFIEX[1] Consultation Letter.

Project Cost (Unit: R$ 1.000)

Items	Total Project Cost
Construction	1,007,722
Consulting Services	30,000
Energy Efficiency Program	29,000
Total	**1,066,722**

As established previously, source of funds was analyzed for expenditures of each project. Usually, the cost estimate breaks down the components of internal and external debt. However, under this Program, 100% of material and equipment is possible to be supplied internally. Because Sabesp is a mixed company where the Government of the State of São Paulo holds 58.28% of the company shares (June 2009), and is managed as provided in the state law that regulates the corporation activities, notwithstanding the loan will come from Japan's Official Development Assistance – ODA, it will be considered as a Sabesp revenue and all financed funds will be considered as internal debt.

29. Financial Evaluation

As a result of Water Loss Reduction activities, the water loss volume will be reduced. Reduced water loss volume is known as recovered water volume. The Feasibility Study Group estimated the real cash

[1] Foreign Financing Commission – Ministério do Planejamento, Orçamento e Gestão

flows to obtain the Net Present Value (NPV) at a 12% discount rate, and the Internal Rate of Return (IRR). Based on standard possibility of sale of 60% of recovered water volume, IRR will be 7.89% in M, 13.46% in R, and 10.58% in Sabesp. The Internal Rate of Return is higher than the rate calculated for long-term projects, thus suggesting that the program under JICA Stage is financially adequate.

30. Economic Evaluation

Water demand in Sabesp operation areas increases year after year. A project is underway for exploration of new resources to meet the increasing water demand that could not be met by the current production volume. The reduction of production volume and the satisfaction of new demands are expected from the use of recovered water volume under the Corporate Water Loss Reduction Program. As a result, investment in exploration of new water resources may be delayed until a future time. Assuming the effect of postponed investment in exploration of new water resources as an economic benefit, the Internal Rate of Return (IRR) was calculated. The updated value of benefit from investment postponement is estimated in R$ 71,564 million. IRR calculation is based on the sum of this financial benefit plus the financial benefit. IRR (when 60% of recovered volume is sold)) is 17.87%. This IRR is higher than the opportunity cost prevailing in Brazil[2], what makes this project be also considered as economically feasible.

31. Social Evaluation

Impacts caused by the PROGRAM on the population are indicated in the 4 following items:

- Consumers' increased satisfaction with improved service level;
- Contribution to service standardization;
- Contribution to saving of resources and energy; and
- Influence on other water projects in Brazil and abroad.

32. Technical Evaluation

From the technical standpoint, we estimate that the requested loan for the PROGRAM during JICA Stage is technically and economically feasible.

1) Project and planning capacity

- Water loss reduction method is emphasized by improved infrastructure and pressure control in distribution networks.
- Planned centralization with the implantation and selection of priority group is appropriate

[2] The long-term interest rate prevailing in Brazil, which was in the range of 13% in 2008, has shown a strong decline trend since January 2009, influenced by the world crisis started in September 2008. The interest rate of 13% prevailing in 2008 was adopted as standard long-term interest rate for this economic evaluation. On July 23, 2009, after COPOM meeting, Banco Central do Brasil announced the reduction of Selic rate by 0.5% to 8.75%. There were 5 interest rate decreases since the beginning of 2009, amounting to 5%. Stagnation of internal economy and the inflation rate trend are behind that interest rate reduction

from the technical view.

- We find that it is technically adequate to anticipate PROGRAM common actions for the whole company to plan water loss reduction at global level.
- Although there is some variation in Business Unit execution capacity, we estimate that their capacity is appropriate to PROGRAM implantation.

2) Execution capacity

- Basically there are no problems with action implementation techniques.
- With respect to inspection of execution of works, it is possible to increase capacity until the PROGRAM starts;
- Regarding the "Standardization of methods of execution of works" and "Inspection of execution of works", each Business Unit together with Eficaz Project is planning the organization and implementation of training courses until the start of PROGRAM.
- Even with respect to quality control of execution of works, is possible to increase capacity until the start of PROGRAM.

3) Capacity for operational continuity

- The organizational framework for Water Loss Control in each Business Unit is generally consistent.
- Management and maintenance based on SGP – Loss Management System will be established.

4) Technique for efficient use of energy

Program for efficient use of energy, which is one of JICA Stage components, includes a technically pertinent project.

- Quality control of pump rotations is a valid method for energy saving.
- In terms of the whole company, it is possible to expand energy saving activities.

33. General Evaluation

Feasibility study of JICA Stage was conducted according to the presentation above, and the general conclusion is the feasibility of activities. We highlight the following three items:

(1) Expression of sustainability effects

It is currently underway in Sabesp the "Corporate Water Loss Reduction and Energy Efficiency Program" (a.k.a. "PROGRAM"), covering a period of 11 years, from 2009 to 2019. Traditionally in Sabesp, long-term programs are 5-year programs, being therefore this long-term 11-year program its first experience of the kind. In Sabesp, 15 Business Units and one Water Production Unit (MA) and Sewage Treatment Plant (MT) manage water and sewerage, each in its respective jurisdiction. Units are extremely independent structures, each of which used to adopt its own methodology, even in

connection with water loss reduction activities. Under the Corporate PROGRAM, Sabesp is planning, discussing and implementing interrelated activities in the organization, which are aimed to reduce losses. There is no doubt that, under the corporate governance view, it will be a PROGRAM of high significance for the establishment of future long-term programs in Sabesp.

JICA Stage consists of activities financed over a period of three of 11 years of PROGRAM. To allow the sustainability effect to appear, it is believed that continued support is necessary, in the form of follow-up, technological aspects and know-how related to sustainable operation and maintenance during and after the PROGRAM implementation.

With respect to results from the PROGRAM, there are many unknown aspects. It is extremely important the cyclic process of making evaluations and reviews of actions after measurements and monitoring of completed actions and their results, as well as the effective reduction of loss rates every fiscal year.

(2) Relationship with Eficaz Project.

Sabesp conducts its business in a vertical and extremely independent manner among its units, resulting in few cross-activities in the organization. However, it is possible to note information sharing in the PROGRAM, a practice that has been encouraged by Eficaz Project, as well the dissemination of the concept that water loss reduction is the result of an integrated management, strongly emphasized by Eficaz Project.

Eficaz Project workshop held in August 2009 was attended by several Business Units, each of which shared its experience through many presentations. We also noted an interaction among UNs in sessions of questions and answers not only about Eficaz Project activities, but also about water loss reduction activities in each Business Unit. It is possible to note in the PROGRAM some advances achieved with the support of Eficaz Project. The company recognizes the importance of Eficaz Project, JICA Feasibility Study Mission, and the improved "qualify of execution of works" and inspection of services and works by Sabesp employees.

(3) Expectations from its Role of South American Leading Company

Water and sewerage sector has been the greatest focus of attention over the last years in Central America, South America and Caribbean Region, and is also a sector with great achievements in yen loans granted by Japan. Guarantee of operation and maintenance after application of funds is indispensable to allow the development effects to appear. However, we cannot say that the capacity or structure of countries is sufficient as far as operation and maintenance are concerned. Water loss reduction activities are still incipient in South American countries, where nothing is consolidated at the moment. Upon the PROGRAM implementation, Sabesp is expected to play a vanguard role in such

activities and become the Leading Company in South America. Through the changes made to its articles of incorporation, Sabesp is today authorized to perform its activities out of the State of São Paulo. There is much to be expected from the dissemination of concept and technology related to water loss reduction, through knowledge and experience offered by S