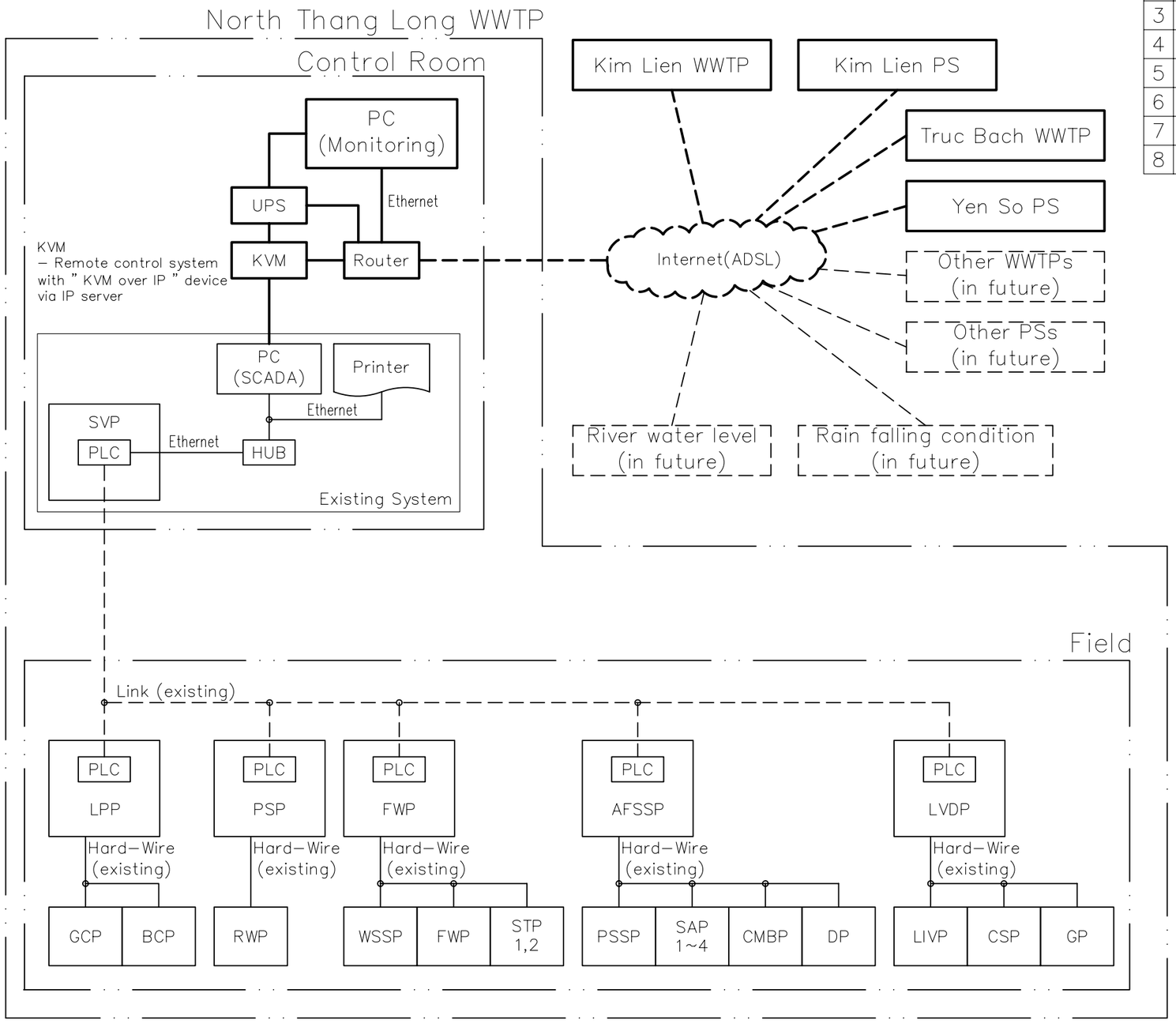
Appendix 3 Integrated Control System Design Drawings

1) System Diagram of North Thang Long WWTP (Drawing No. G9607-RGED-01)
2) System Diagram of Kim Lien WWTP (Drawing No. G9607-RGED-02)
3) System Diagram and Cable Layout of Kim Lien PS (Drawing No. G9607-RGED-03)
4) System Diagram of Truc Bach WWTP (Drawing No. G9607-RGED-04)
5) System Diagram of Yen So PS (Drawing No. G9607-RGED-05)
6) North Thang Long WWTP Control Room Layout Plan (Drawing No. G9607-RGED-06)
7) Cable Layout of Kim Lien WWTP (Drawing No. G9607-RGED-07)
8) Cable Layout of Truc Bach WWTP (Drawing No. G9607-RGED-08)
9) Yen So Pumping Station Control Room Layout Plan (Drawing No. G9607-RGED-09)

	Function
1	Monitoring and checking all other facilities status in North Thang Long WWTP
2	Total Management of all Logging data via internet
3	Monitoring and checking North Thang Long WWTP status
4	New UPS will supply the power for new system
5	Monitoring other WWTPs, other PSs, river status, rain falling condition (in future)
6	
7	
8	

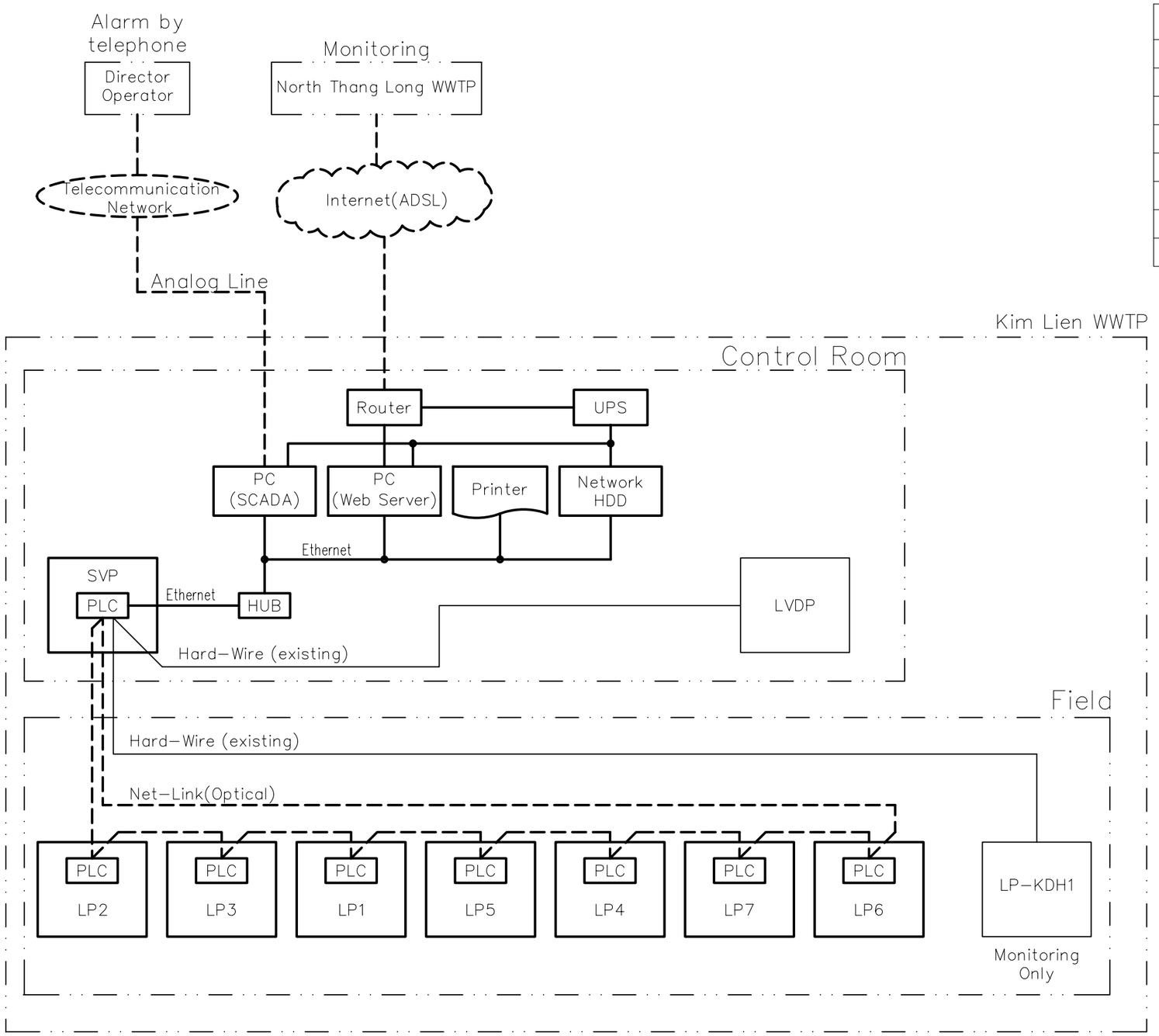


: New

Job Title	Strengthening of O&M of Sewerage Facilities in Hanoi		
Drawing Title	System Diagram of North Thang Long WWTP		
Drawing No	G9607–RGED–01	Scale	not scale

NIHON HELS INDUSTRY CORPRATION

A3



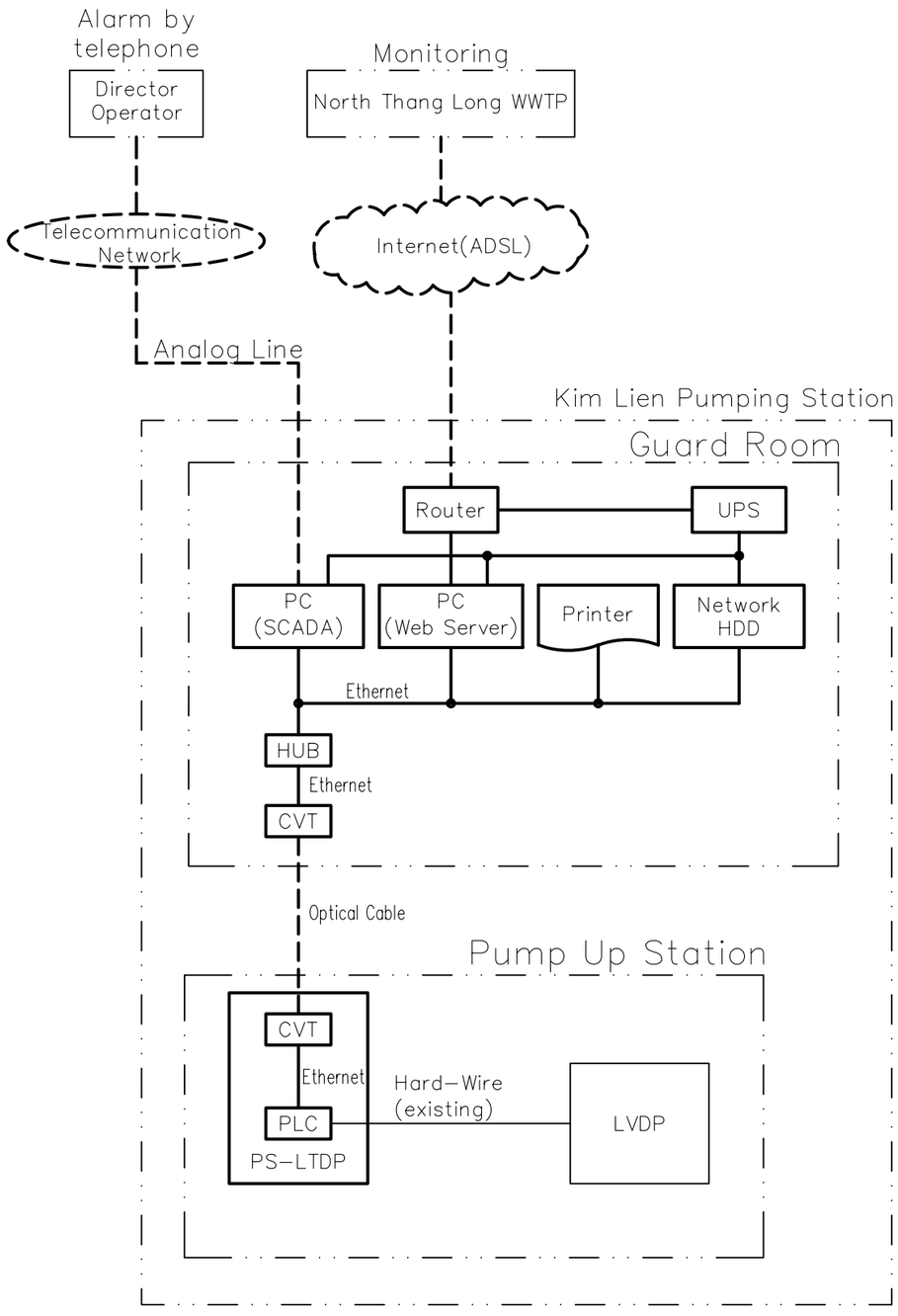
	Function
1	PLC redundant system (CPU, Power source, Network Only)
2	SCADA System for Status monitoring and controlling
3	Web Server for monitoring at North Thang Long WWTP
4	Alarm system by telecommunication network in failure case
5	Logging System with SCADA PC data-base and Printer
6	Network HDD for Backing-up data base files
7	Manual ON-OFF function will be installed in Control Room System
8	New UPS will supply the power for new system (SCADA PC, Server PC, HDD, Router)

: New

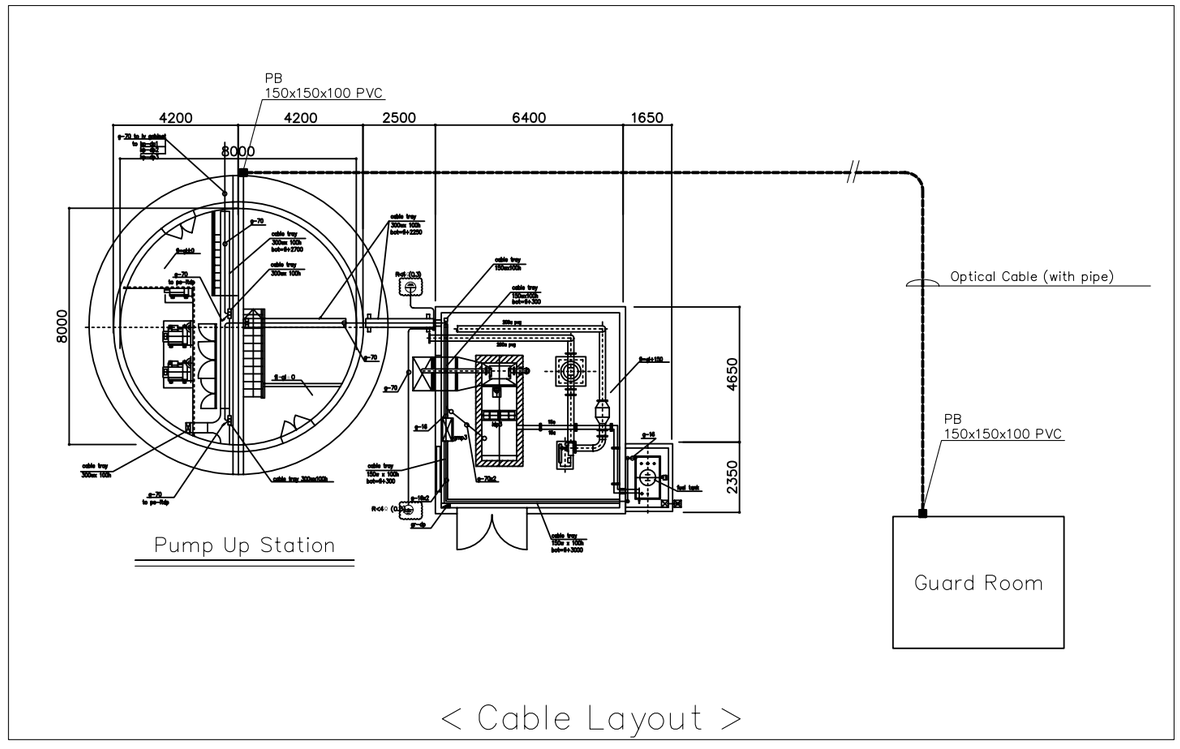
Job Title	Strengthening of O&M of Sewerage Facilities in Hanoi		
Drawing Title	System Diagram of Kim Lien WWTP		
Drawing No	G9607-RGED-02	Scale	not scale

NIHON HELS INDUSTRY CORPRATION

A3



Function	
1	PLC redundant system (CPU, Power source Only)
2	SCADA System for Status monitoring and controlling
3	Web Server for monitoring at Guard Room, Kim Lien WWTP and North Thang Long WWTP
4	Alarm system by telecommunication network in failure case
5	Logging System with SCADA PC data-base and Printer
6	Network HDD for Backing-up data base files
7	New UPS will supply the power for new system (SCADA PC, Server PC, HDD, Router)
8	



< Cable Layout >

: New

Note

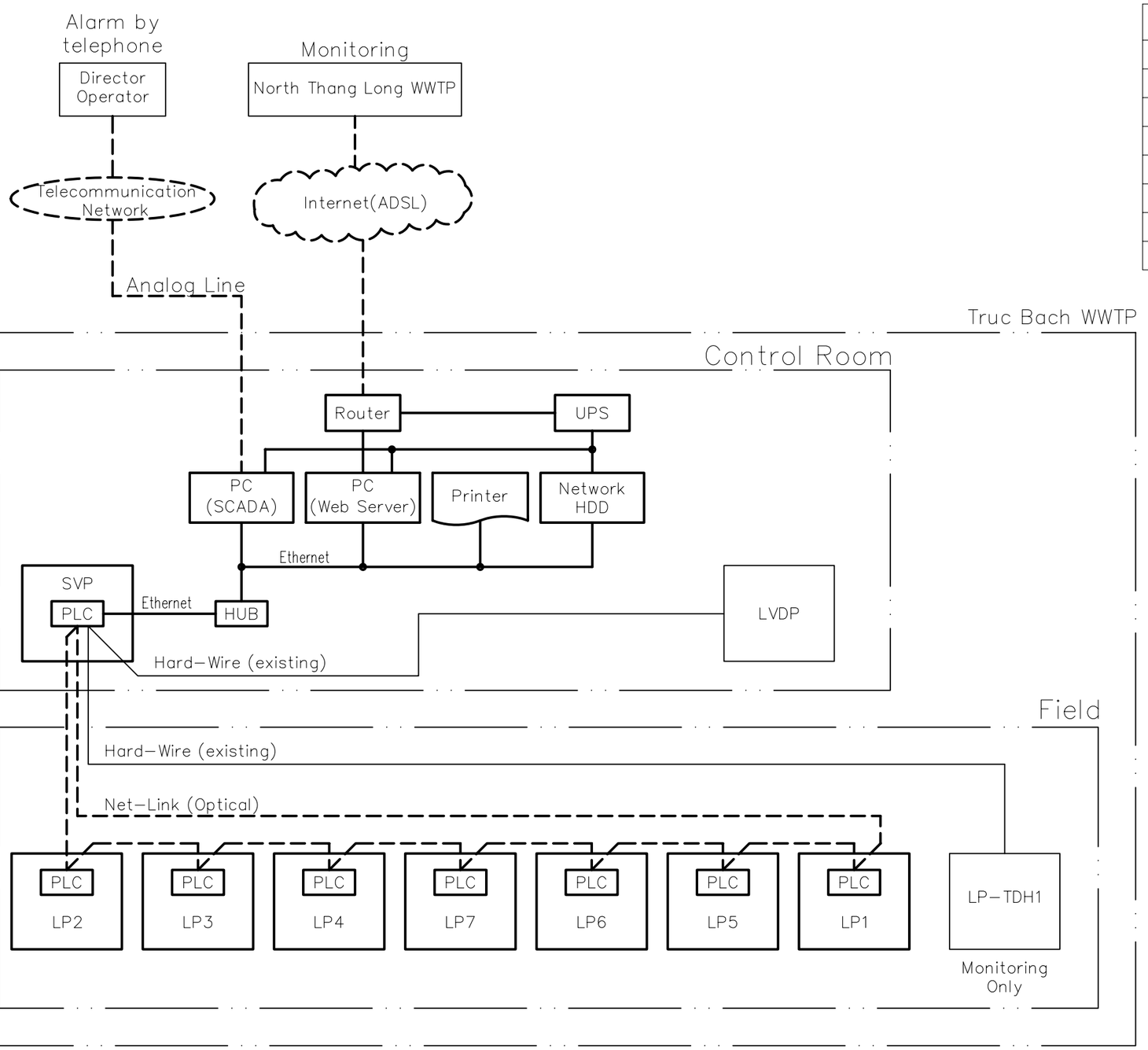
1 CVT: Media Converter

* Media Converter is converting signals between Ethernet and Optical

Job Title	Strengthening of O&M of Sewerage Facilities in Hanoi		
Drawing Title	System Diagram and Cable Layout of Kim Lien PS		
Drawing No	G9607-RGED-03	Scale	not scale

NIHON HELS INDUSTRY CORPRATION

A3



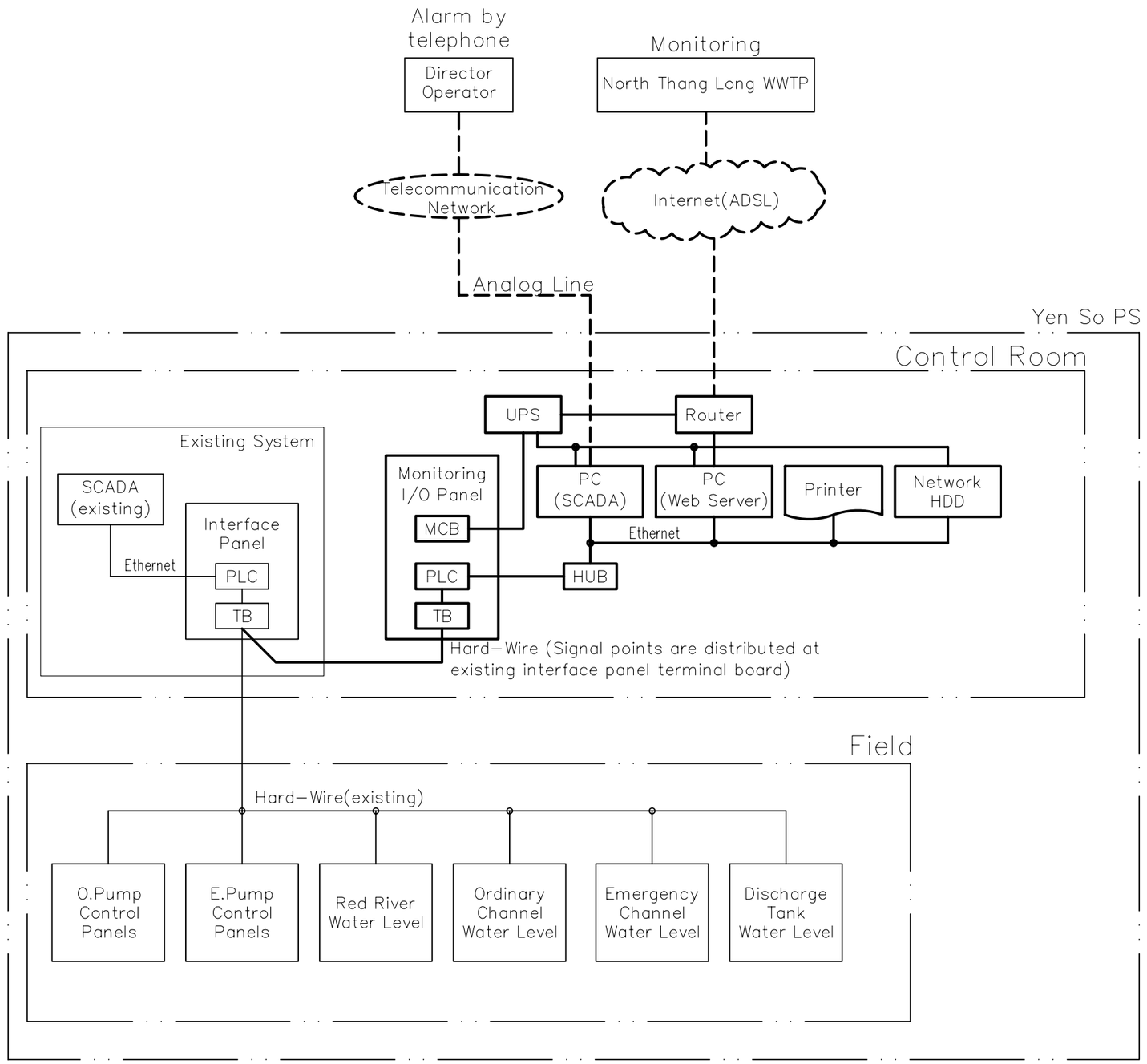
	Function
1	PLC redundant system (CPU, Power source, Network Only)
2	SCADA System for Status monitoring and controlling
3	Web Server for monitoring at North Thang Long WWTP
4	Alarm system by telecommunication network in failure case
5	Logging System with SCADA PC data-base and Printer
6	Network HDD for Backing-up data base files
7	Manual ON-OFF function will be installed in Control Room System
8	New UPS will supply the power for new system (SCADA PC, Server PC, HDD, Router)

: New

Job Title	Strengthening of O&M of Sewerage Facilities in Hanoi		
Drawing Title	System Diagram of Truc Bach WWTP		
Drawing No	G9607-RGED-04	Scale	not scale

NIHON HELS INDUSTRY CORPRATION

A3



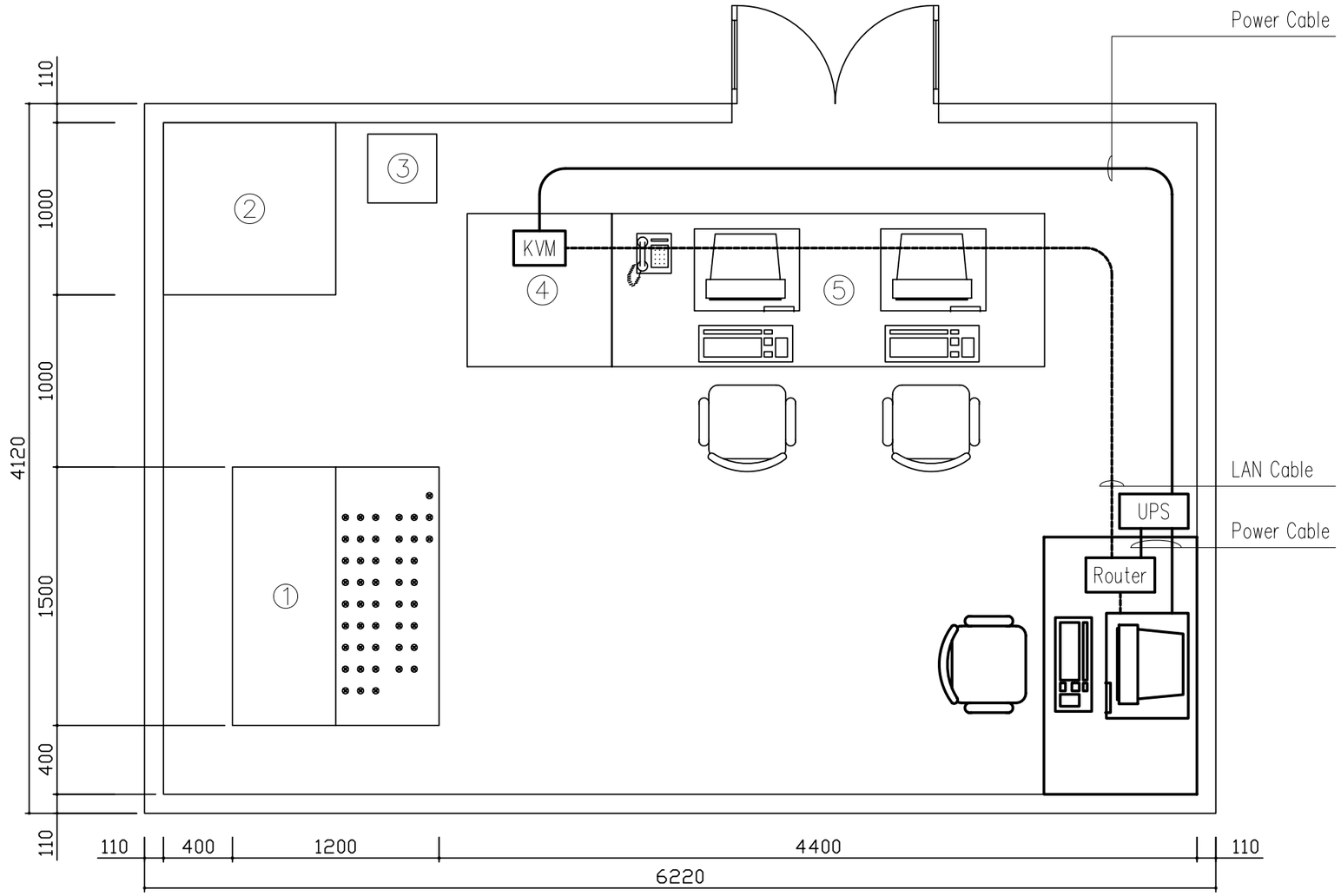
Function	
1	SCADA System for Status monitoring
2	Web Server for monitoring at North Thang Long WWTP
3	Alarm system by telecommunication network in failure case
4	Logging System with SCADA PC data-base and Printer
5	Network HDD for Backing-up data base files
6	Manual ON-OFF function will be installed in Control Room System
7	New UPS will supply the power for new system (SCADA PC, Server PC, HDD, Router)
8	

: New

Job Title	Strengthening of O&M of Sewerage Facilities in Hanoi		
Drawing Title	System Diagram of Yen So PS		
Drawing No	G9607-RGED-05	Scale	not scale

NIHON HELS INDUSTRY CORPRATION

A3



Legend (existing):

①	Supervisory Panel
②	Battery Charge
③	UPS
④	Printer Desk
⑤	Computer Desk

Note:

1 New Monitoring PC system power will be supplied by new UPS (including KVM and Router)

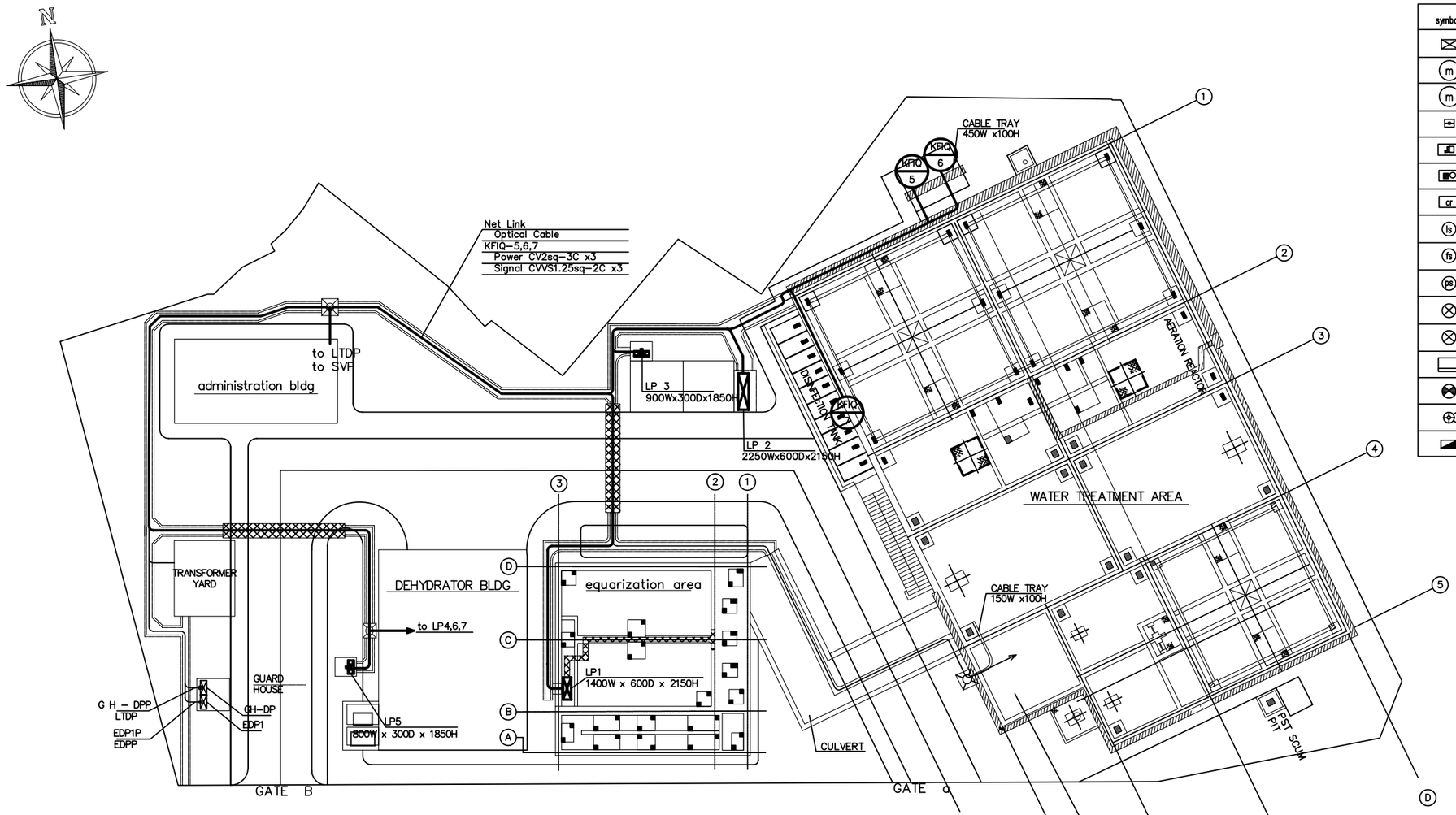
2 New UPS power is supplied by outlet

: New

Job Title	Strengthening of O&M of Sewerage Facilities in Hanoi		
Drawing Title	North Thang Long WWTP Control Room Layout Plan		
Drawing No	G9607-RGED-06	Scale	1/30

NIHON HELS INDUSTRY CORPRATION

A3



legend

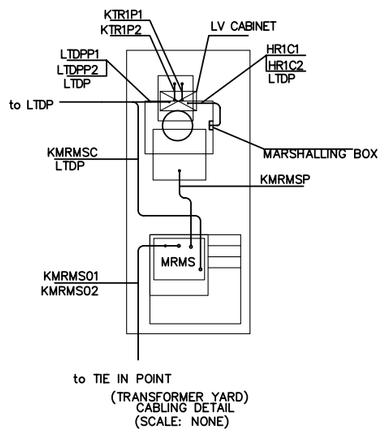
electrical & instrument equipment

symbol	description
	local panel
m	motor
m S	submersible motor w/ lead cable
	operating switch
	juntion box w/ termical block 10p
	welding outlet ac400v-16a 3p+e
cr	convenience receptacle
ls	level switch electrice type
fs	level switch float type
ps	pressure switch
	ultrasonic level meter
	maghetic flow meter
	dissolved-oxygen converter
	dissolved-oxygen sensor
	motor operated valve
	lighting distribution panel

SYMBOL	DESCRIPTION
	CABLE TRAY
	CABLE TRENCH
	DUCT BANK
	HANDHALL
	ABOVEGROUND CABLING
	ABOVEGROUND CABLING
LOWER UPPER	VERTICAL PART OF CABLING
	CABLING UP
	CABLING DOWN
	LOCAL PANEL
	GROUNDING ELECTROD/ GROUNDN WELL Cu BAR
	GROUNDING WIRE CONNECTION POINT
	GROUNDING TERMINAL

Note

1 Net Link Optical cable connection is refer to DWG No. G9607-RGED-02
2 SVP and Local Panels (LP1-7) are replaced
3 KFIQ-5,6: Return Sludge Flow Meter (New)
Type Ultrasonic flow meter
Cables from SVP to KFIQ-5,6
Power: CV2sq-3C x2
Signal(4-20mADC): CVVS1.25sq-2C x2
4 KFIQ-7: Effluent Flow Meter (New)
Type Weir type flow meter
Cables from SVP to KFIQ-7
Power: CV2sq-3C
Signal(4-20mADC): CVVS1.25sq-2C

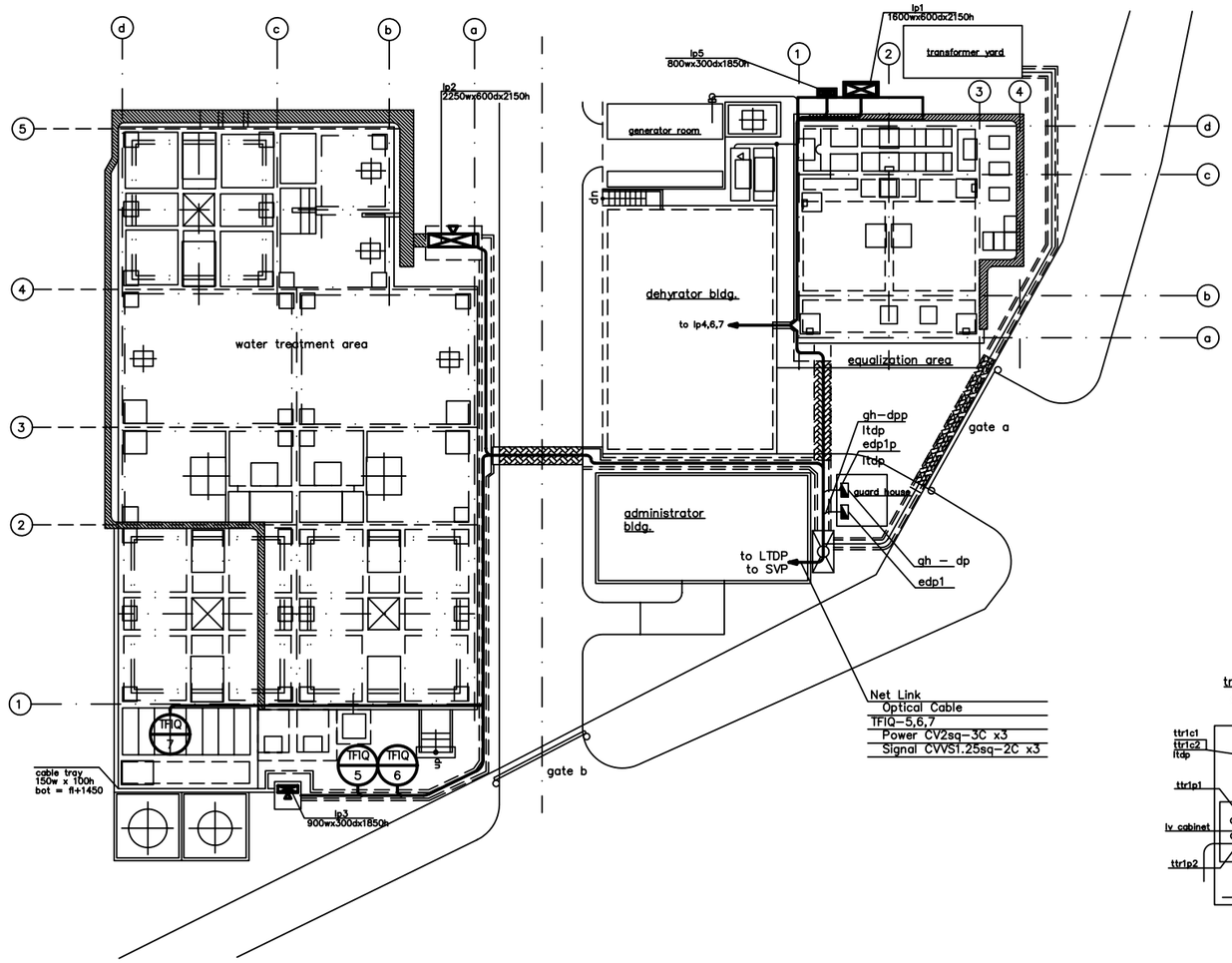


CABLING DETAIL
(SCALE: NONE)

: New

Job Title	Strengthening of O&M of Sewerage Facilities in Hanoi		
Drawing Title	Cable Layout of Kim Lien WWTP		
Drawing No	G9607-RGED-07	Scale	1/150

NIHON HELS INDUSTRY CORPRATION



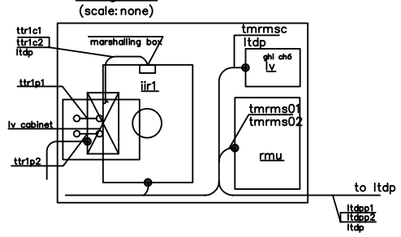
legend

electrical & instrument equipment

symbol	description
	local panel
m	motor
m S	submersible motor w/ lead cable
	operating switch
	juntion box w/ termical block 10p
	welding outlet ac400v-16a 3p+e
cr	convenience receptacle
ls	level switch electrice type
fs	level switch float type
ps	pressure switch
	ultrasonic level meter
	maghetic flow meter
	dissolved-oxygen converter
	dissolved-oxygen sensor
	motor operated valve
	lighting distribution panel

SYMBOL	DESCRIPTION
	CABLE TRAY
	CABLE TRENCH
	DUCT BANK
	HANDHALL
	ABOVEGROUND CABLING
	ABOVEGROUND CABLING
LOWER UPPER	VERTICAL PART OF CABLING
	CABLING UP
	CABLING DOWN
	LOCAL PANEL
	GROUNDING ELECTROD/ GROUNDN WELL, Cu BAR
	GROUNDING WIRE CONNECTION POINT
	GROUNDING TERMINAL

transformer yard
cabling detail
(scale: none)



Note

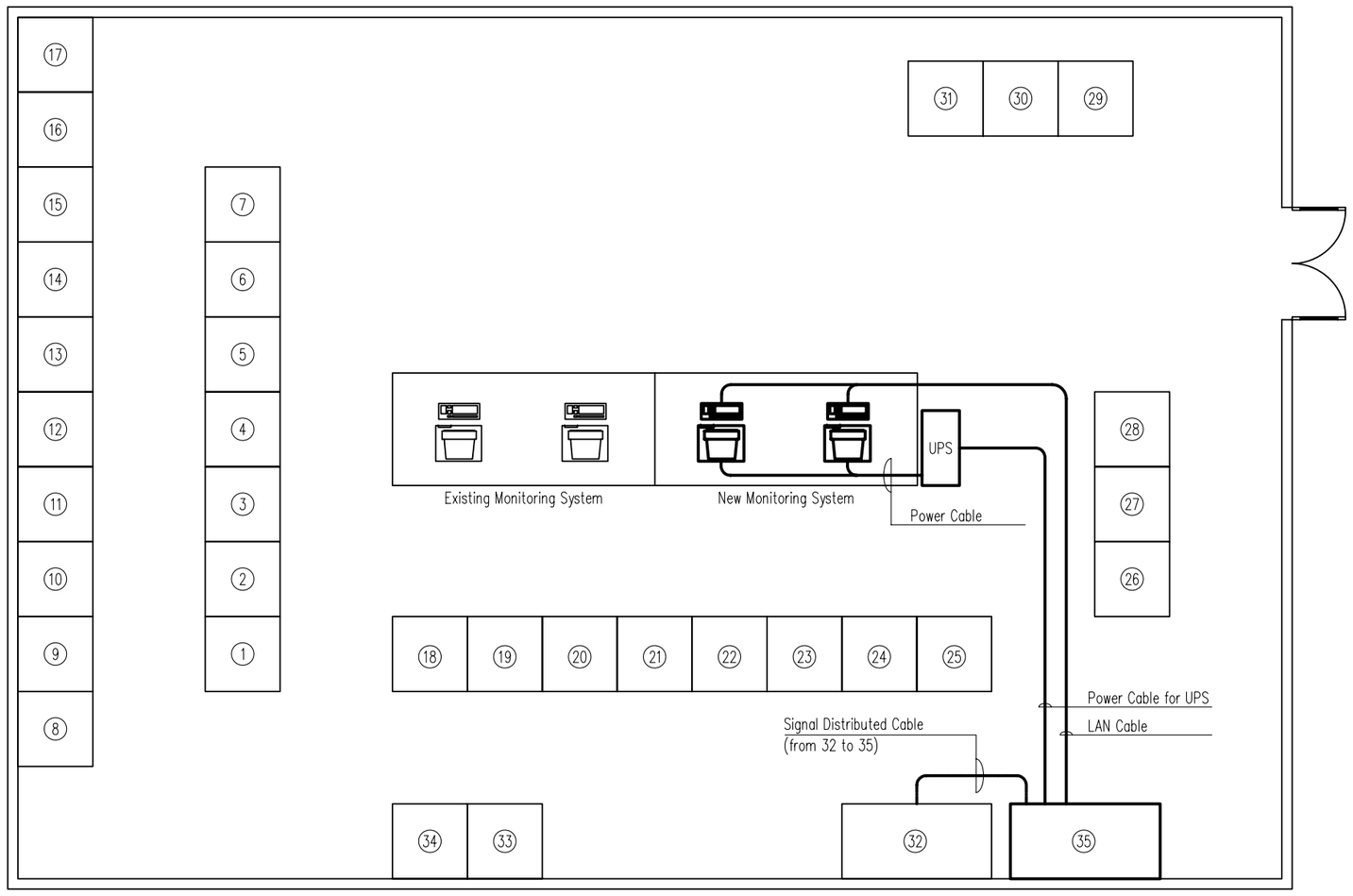
1 Net Link Optical cable connection is refer to DWG No. G9607-RGED-04
2 SVP and all Local Panels (LP1-7) are replaced
3 TFIQ-5,6: Return Sludge Flow Meter (New)
- Type: Ultrasonic flow meter
- Cables: from SVP to TFIQ-5,6
  - Power: CV2sq-3C x2
  - Signal(4-20mADC): CVVS1.25sq-2C x2

4 TFIQ-7: Effluent Flow Meter (New)
- Type: Weir type flow meter
- Cables: from SVP to TFIQ-7
  - Power: CV2sq-3C
  - Signal(4-20mADC): CVVS1.25sq-2C

: New

Job Title	Strengthening of O&M of Sewerage Facilities in Hanoi		
Drawing Title	Cable Layout of Truc Bach WWTP		
Drawing No	G9607-RGED-08	Scale	1/150

NIHON HELS INDUSTRY CORPRATION



Legend:

1. 22kv s/g no .1
2. 22kv s/g no .2
3. Main Tr (No.1)
4. 6kv s/g no .1
5. 6kv s/g no .2
6. Main Tr (No.2)
7. lv s/g & aux.tr
8. o. Pump No.1–No.5
9. e. Pump No.1–5
10. e. Pump No.6–10
11. e. Pump No.11–15
12. 22kv s/g
13. Main Tr (No.1)
14. Main Tr (No.2)
15. 6kv s/g
16. Aux. Tr. No.1 & No.2
17. lv s/g
18. e.Pump No.12 & No.14
19. e.Pump No.8 & No.10
20. e.Pump No.6
21. e.Pump No.2 & No.4
22. e.Pump No.3 & No.1
23. e.Pump No.7 & No.5
24. e.Pump No.11 & No.9
25. e.Pump No.13 & No.15
26. o. Pump No.2 & No.4
27. o. Pump No.1 & No.3
28. o. Pump No.5 & spare
29. no.2 battery charger
30. dc switchboard
31. no.1 battery charger
32. Interface panel
33. E.Pump Auto start and stop
34. O.Pump Auto start and stop
35. Monitoring I/O Panel

Note:

1 Signal points are distributed at existing interface panel terminal board (laying on cable is also included)

: New

Job Title	Strengthening of O&M of Sewerage Facilities in Hanoi		
Drawing Title	Yen So Pumping Station Control Room Layout Plan		
Drawing No	G9607-RGED-09	Scale	1/60

NIHON HELS INDUSTRY CORPRATION

A3

Appendix 4 Trainees' List

1. First Course List

2. Second Course List

3. Third Course List

HANOI PEOPLE'S COMMITTEE
HANOI SEWERAGE & DRAINAGE ONE-MEMBER LIMITED COMPANY

SOCIALIST REPUBLIC OF VIETNAM
Independence – Freedom - Happiness
--------***--------

Hanoi, date month 2010

TRAINEE LIST ATTENDED THE TRAINING COURSE UNDER THE PROJECT OF
STRENTHENING OF OPERATION AND MAINTERNANCE FOR SEWERAGE AND DRAINAGE FACILITIES IN HANOI
THE FIRST TIME *FROM JULY 12, 2010 TO JULY 17, 2010*
(Attached to official correspondence no. 763/TNHN dated July 5, 2010 of Hanoi Sewerage & Drainage One-Member Limited Company)

No	Full Name	Date of Birth	ID No.	Level	Office Address
1	Tran Phu Quy	June 25, 1975	201274195 issused in July 30, 1992 at the Post Office of Quang Nam Da Nang Province	Engineer of Technical Electric	Staff of Technical Departmenet – Danang Drainage and Waste Water Treatment Plant
2	Nguyen Thi Duc	Nov. 16, 1982	201475207 issused in Sep. 07, at the Post Office of Quang Nam Da Nang Province	Bachelor of Environment	Staff of Planning Department – Danang Drainage and Waste Water Treatment Plant
3	Nguyen Duy Canh	Apr. 10, 1979	201400765 issused in Mar. 09, 2010 at the Post Office of Quang Nam Da Nang Province	Građuate from the College of Construction	Deputy Manager of Hoa Cuong Waste Water Treatment Plant - Danang Drainage and Waste Water Treatment Plant
4	Nguyen Van Hung	Jun. 25, 1981	201456565 issused in Mar. 09, 1998 at the Post Office of Quang Nam Da Nang	Electric Worker	Deputy Manager – Son Tra Waste Water Treatment Plant - Danang Drainage and Waste Water Treatment Plant
5	Nguyen Huu Khoa	Feb. 10, 1969	030742051 issused in Mar. 21, 2009 at the Post Office of Hai Phong Province	Engineer of Hydraulic Building	Staff of Technical Departmenet – Haiphong Sewerage & Drainage Company
6	Nguyen Van Phong	Jan. 10, 1980	031015604 issused in May 02, 1995 at the Post Office of Hai Phong Province	Technical Engineer of Infrastructure	Staff of Technical Department – Haiphong Sewerage & Drainage Company
7	Dang Pham Dung	Feb. 25, 1959	173354400 issused in Sep. 27, 2007 at the Post Office of Thanh Hoa Province	Sewerage Engineer	Sewerage & Drainage Team Leader – Thanh Hoa Environmental & Urban Works Company
8	Vu Ngoc Kien	Jun. 07, 1982	171661767 issused in Jun. 23, 1998 at the Post Office of Thanh Hoa Province	Water resouce Engineer	Executive - Thanh Hoa Environmental & Urban Worrks Company
9	Tran Ngoc Long	Oct. 22, 1965	050260088 ngµy 6/11/2008 at the Post Office of Son La Province	Bachelor of Construction University	Constructional Team Leader – MTV Son La Urban Environment State-owned Limited Company
10	Ta Van Tuan	Jan. 10, 1984	050459189 issused in Mar. 27, 2002 at the Post Office of Son La Province	Bachelor of Transportation University	Technical staff of Project Management - MTV Son La Urban Environment State-owned Limited Company

PC OF HA NOI
HSDC

VIETAM SOCIALIST REBLIC
Independence – Freedom - Happiness
--------***--------

Hanoi, date month 2010

TRAINEES LIST ATTENDED THE TRAINING UNDER THE PROJECT OF
"STRENGTHENING OF OPERATION AND MAINTERNANCE FOR SEWERAGE AND DRAINAGE FACILITIES IN HANOI"
THE SECOND TIME F*ROM SEP 06, 2010*

No	Full Name	Date of Birth	ID No.	Level	Office Address
1	Pham Thai Son	13/9/1979	162256119	Irrigation Engineer	Nam Dinh Urban and Enviroment Company
2	Pham Truong Giang	6/6/1974	161976425	Electrical Engineer	Nam Dinh Urban and Enviroment Company
3	Nguyen Xuan Ha	5/5/1958	090595715	Water Supply and Drainage Engineer	Thai Nguyen Urban and Facility Company
4	Nguyen Van Tuyen	12/9/1980	090919787	Technical Worker	Thai Nguyen Urban and Facility Company
5	Nguyen Thanh Hung	28/2/1981	141982872	Water Supply and Drainage Engineer	Hai Duong Urban Facility Management Company
6	Dang Xuan Huong	28/12/1978	141849177	Electrical Engineer	Hai Duong Urban Facility Management Company
7	Nguyen Van Thang	19/12/1977	168459605	Engineer	Ha Nam Urban Facility and Environment Company
8	Vu Xuan Hoa	4/5/1986	168145406	Worker	Ha Nam Urban Facility and Environment Company
9	Nguyen Hong Phong	24/2/1984	081039481	Engineer	Lang Son Water Supply and Drainage
10	Phan Thanh Hong	10/10/1965	080916570	Worker	Lang Son Water Supply and Drainage

PC OF HA NOI
HSDC

VIETAM SOCIALIST REBLIC
Independence – Freedom - Happiness
--------***--------
Hanoi, date month 2010

TRAINEES LIST ATTENDED THE TRAINING UNDER THE PROJECT OF
"STRENTHENING OF OPERATION AND MAINTERNANCE FOR SEWERAGE AND DRAINAGE FACILITIES IN HANOI
THE THIRD TIME F*ROM SEP 13, 2010*

No	Full Name	Date of Birth	ID No.	Level	Office Address
1	Nguyen Hoang Phuc	1970	191157971	Civil engineer	Hue Environement & Urban Facilities Limited Company
2	Nguyen Phuoc Vinh Tu	1983	191479855	Civil engineer	Hue Environement & Urban FacilitiesLimited Company
3	Tran Quoc Vinh	1983	311709791	Environment Engineer	HCMC Urban Drainage & Sewerage 1 member Limited Company
4	Tran The Lam	1983	194212067	Environment Engineer	HCMC Urban Drainage & Sewerage 1 member Limited Company
5	Pham Thanh Hung	1980	280715802	Environment Engineer	Binh Duong Environmental Drainage & Sewerage 1 member Limited Company
6	Phan The Anh	1983	280806038	Sewerage Engineer	Binh Duong Environmental Drainage & Sewerage 1 member Limited Company
7	Tran Nam Ninh	1986	280845616	Sewerage	Binh Duong Environmental Drainage & Sewerage 1 member Limited Company
8	Bach Van Luan	1983	135181296	Engineer	Vinh Phuc Environmental Improvement Investment Project Management Board
9	Nguyen Ba Loc	1982	135064322	Engineer	Vinh Phuc Environmental Improvement Investment Project Management Board
10	Nguyen Duy Phu	10/11/1973	112191392		Son Tay Urban Facility and Environement Company
11	Khuat Cao Hien	21/6/1960	112216300	Civil engineer	Son Tay Urban Facility and Environement Company
12	Le Dinh Nguyen	1985	121590737	Environmental Technology	Bac Giang Urban Facilities Management

				Engineer	Joint-Stock Company
13	Chu Viet Trong	1977	121244771	Electric Engineer	Bac Giang Urban Facilities Management Joint-Stock Company
14	Pham Văn Cộng	1969	164051775	Irrigation Engineer	Ninh Binh Urban Facilities Management Joint-Stock Company
15	Pham Giang Nam	13/12/1981	164161354	Sewerage	Ninh Binh Urban Facilities Management Joint-Stock Company

Appendix 5 Textbook for the Training Course

TEXT No.01 Basic of Operation & Maintenance

TEXT No.02 Outline of Sewage Works

TEXT No.03 Maintenance of Machinery of Pumping Station and Sewage Treatment Plant

TEXT No.04 Water Quality Control

TEXT No.01

Basic of Operation & Maintenance (Draft)

Version.1

HANOI SEWERAGE AND DRAINAGE COMPANY

Contents

Introduction

Most of maintenance techniques for sewerage facilities have been built on empirical knowledge. Also, proper maintenance and operation requires broad expertise in areas including mechanical engineering, electrical engineering, biological engineering, chemistry, hydraulic and more. In the process of sewage treatment, troubles may occur due to the intricate combination of numerous factors such as characteristics of inflow sewage, the size and structure of the treatment facilities and the facility layout. Even when action on a problem occurring at one treatment plant is appropriate, it does not guarantee that the same action is effective at another plant. In many cases, each treatment plant needs to configure its own maintenance programs by referring to maintenance programs practiced at other treatment plants. Generally, it is safe to say that the proper maintenance programs are developed through trial and error at respective treatment plants.

Given the above aspects of the matter, for countries planning construction of sewerage facilities, a shortest way of raising the technological level quickly is to dispatch engineers to sewage treatment facilities already in operation to learn from experienced forerunners. It is also a shortest way to transit from construction to operation and maintenance.

Meanwhile, viewed as project operation, sewerage operation requires a long-term stable maintenance. That means it is essential to earmark the budget for that purpose. Then, it is important to obtain users' basic understanding for the collection of sewerage charges and the budget for operation and maintenance and steady PR activities should also take place.

Considering private sector participation, incentives as feasible business are required. To that end, it is important to expand the scope of consignment as much as possible in order to provide consignees with a certain degree of freedom so that they can operate efficiently. On the other hand, however, it is essential for consigners to build a robust operation-checking system.

1. Practical facility management

1.1 Operation and maintenance of sewage treatment facilities

Fig.1.1 shows the operation and maintenance tasks in the water treatment system of the sewage treatment plant.

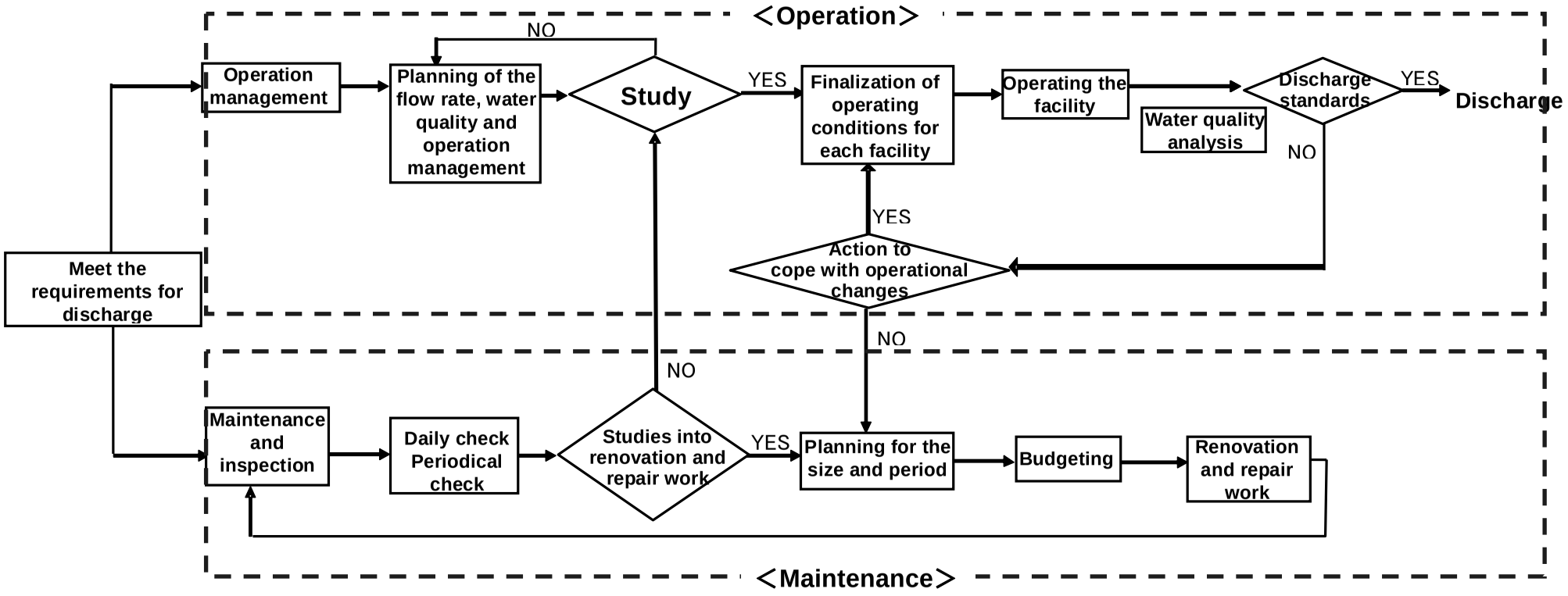


Fig.1.1 Flow of Management Tasks at Sewage Treatment Plant

As shown in Fig.1.1, management of a sewage treatment facility can be divided into operation and maintenance. Additionally, there are important supporting tasks such as procurement and environmental tasks.

1.1.1 Operation

Using facilities developed through maintenance, operation controls the operation of the facilities to comply with the water quality requirements. It must ensure to achieve the required water quality as well as continuous and stable responses to operational fluctuations.

1.1.2 Maintenance

In order to hand over the facilities in a good condition to the operating department, the maintaining department conducts inspection and maintenance of the facilities. Technological and technical competence is required as well as reliability.

1.1.3 Procurement

Long-term inventory management of consumables and replacement parts supports ongoing maintenance. Systematic ledger management is essential.

1.1.4 Other considerations

Greening and cleaning of the sewage treatment facilities must be included in the operation as it involves polluted matters.

The maintenance & management task of the treatment plant is largely divided into three sections, operation and maintenance, facility preservation, and water quality control. The treatment plant requires to be maintained so as it can display 100% of its function at all times, needless to say both day and night. Generally however only the minimum required tasks, out of those included in the plant operation task, are carried during the night, and major O&M tasks are done during the day.

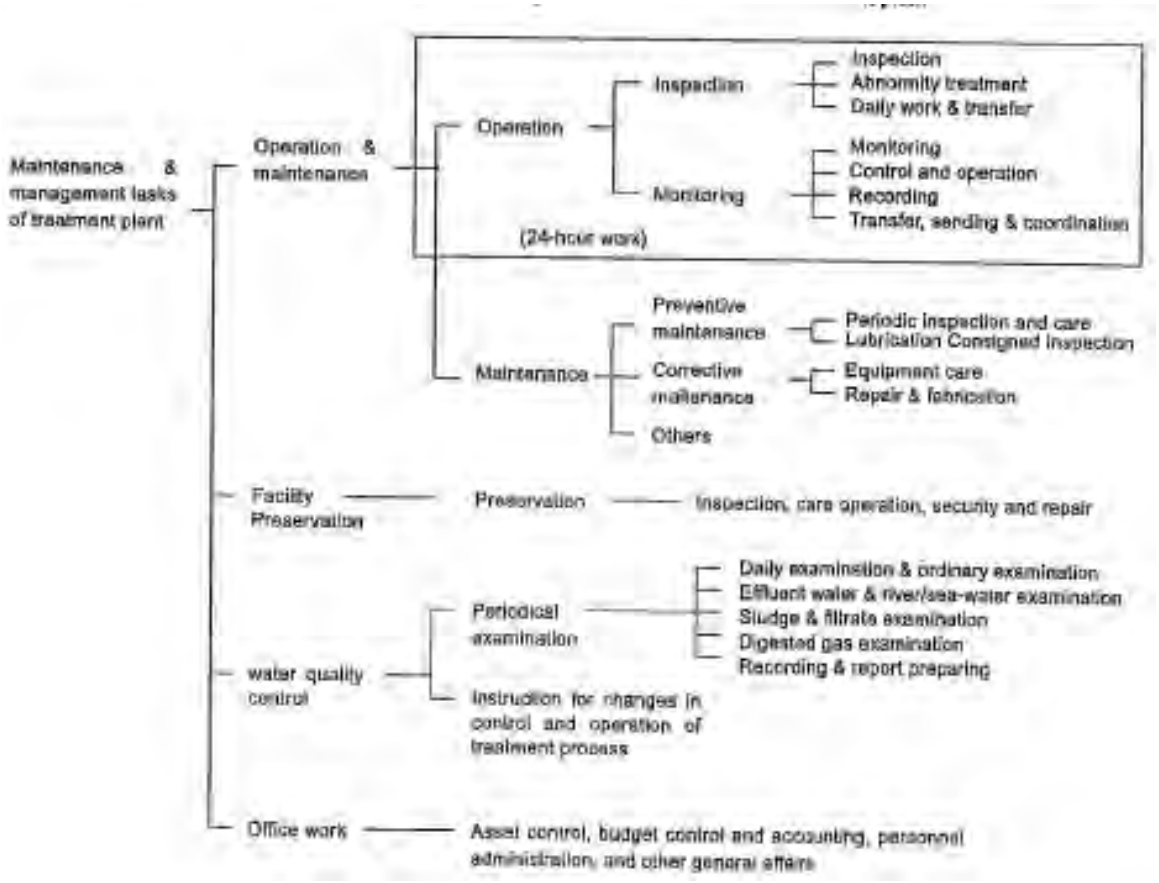


Fig.1.2 O & M job

2. Executive system

The deployment plan for personnel for facility management may vary depending on the facility capacity, facility configuration and the automation level. Generally, however, the automation technology is developing significantly, and personnel for facility management are decreasing in number. Yet, expertise is required for facility management, and, in particular, the following types of engineers must be secured:

- Mechanical engineers
- Electrical engineers
- System engineers
- Water quality management engineers

Depending on the facility size, one engineer may be in charge of multiple technical operations or multiple treatment plants. The following describes the correlation between the size of the treatment facility and the number of personnel for managing it.

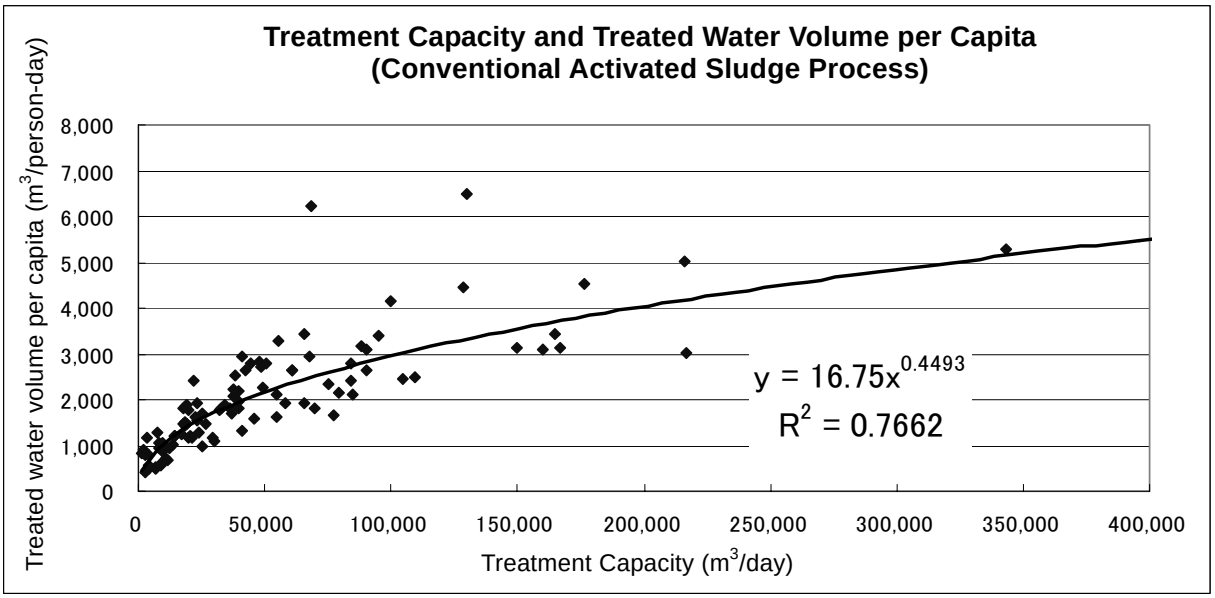


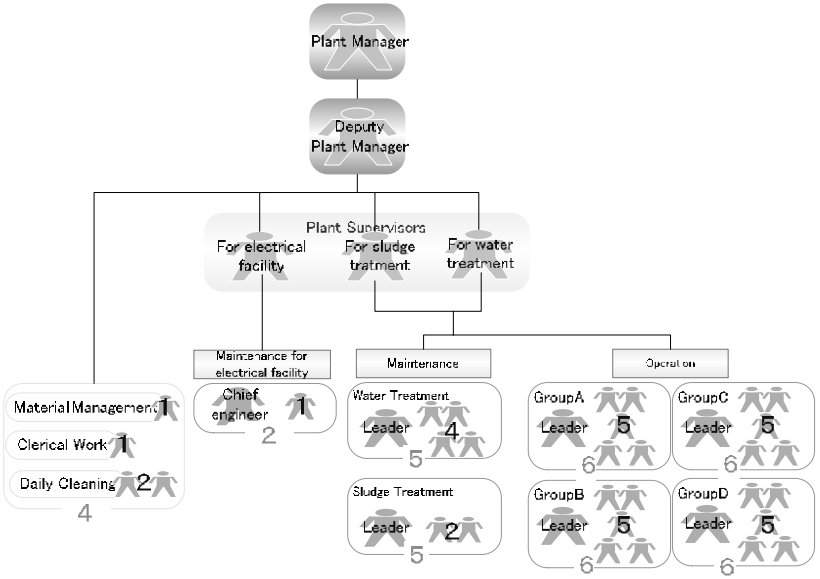
Fig. 2.1 Treatment Capacity and Treated Water Volume per Capita

The following is an example of a deployment plan for personnel in charge of operation and maintenance of a treatment plant.

Plant A

Treatment Capacity : 104,900m3/Day
Collection System : Separate system
Water treatment method: Conventional activated sludge process
Sludge treatment method : Thickening—Dewatering—Incineration
(—Carrying Out)

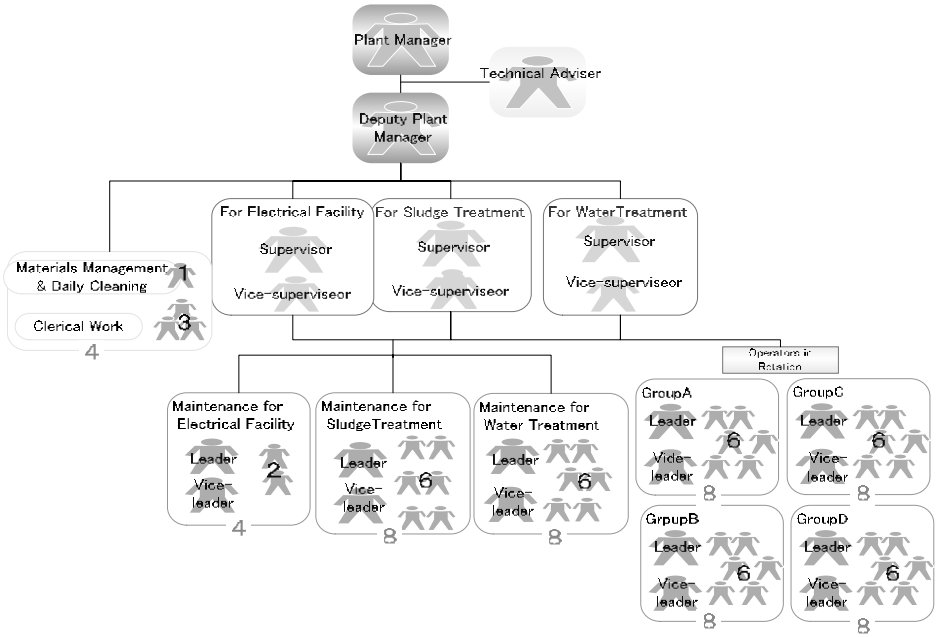
Total 43 persons



Plant B

Treatment Capacity : 343,200m3/Day
Collection System : Separate system
Water treatment method: Conventional activated sludge process
, A2Omethod
Sludge treatment method : Thickening—Dewatering—Incineration
(—Carrying Out)

Total 65 persons

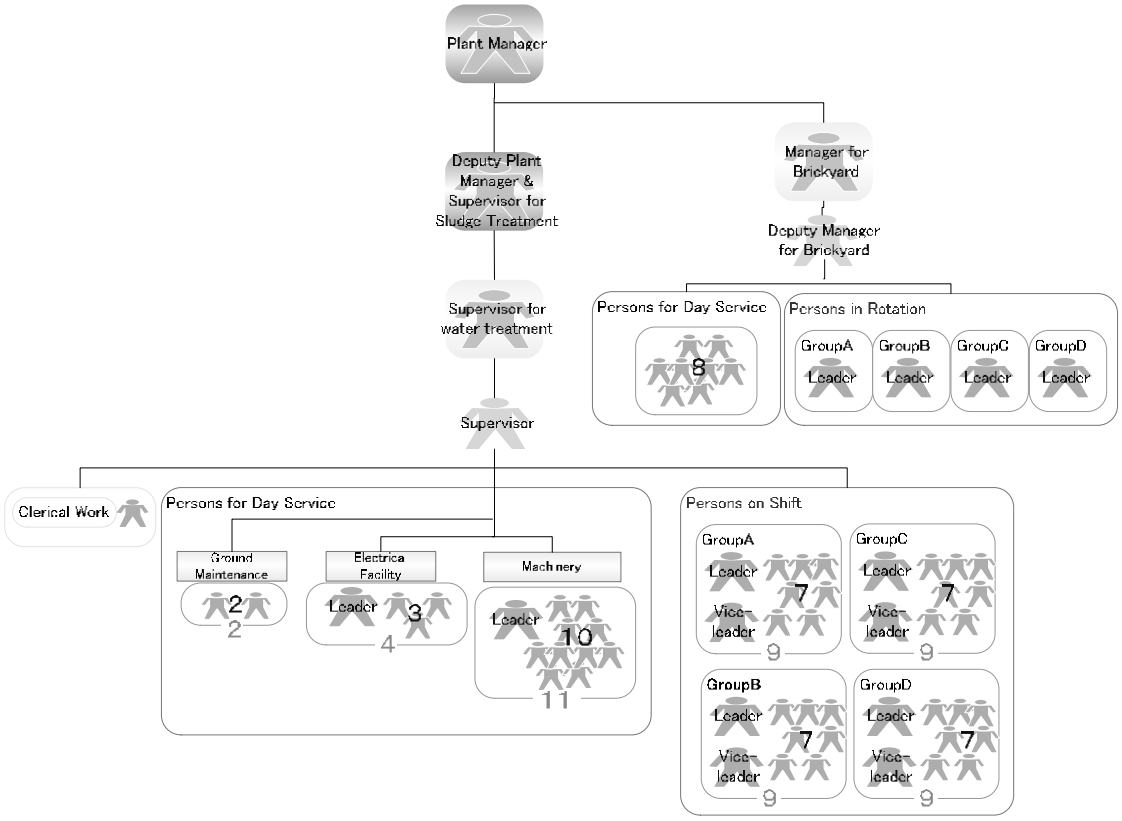


A-119

Plant C

Treatment Capacity : 216,600m3/Day
Collection System : Combined system
Water treatment method: Conventional activated sludge process
Sludge treatment method : Thickening—Dewatering—Incineration
(—Carrying Out)

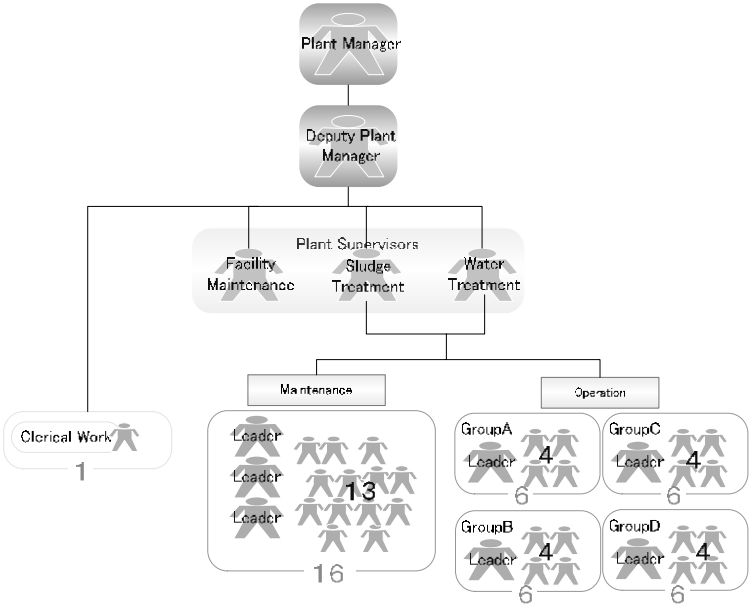
Total 72 persons



Plant D

Treatment Capacity : 175,300m3/Day
Collection System : Separate system
Water treatment method: Conventional activated sludge process
,A2Omethod
Sludge treatment method : Thickening—Dewatering—Incineration
(—Carrying Out)

Total 42 persons



3. Operation

Operation management refers to achieve the objective of proper sewage treatment using the facilities kept in good conditions through maintenance activities.

3.1 Basic control factors for biological treatment

The basic factor for biological treatment is the F/M ratio. Although performance may vary depending on the treatment method and the capacity of the facilities, treatment generally achieves effect unless excessive load is applied by inflow sewage. In aerobic treatment, basic two factors to be controlled in practice are:

- Oxygen amount- operation of an aeration device
- Biomass - operation of a sludge draw-off device

Note, however, that treatment requires adequate considerations not only for organic matters but also for nitrification.

3.2 Operation planning

The most important item in operation management is operation planning. Fig.3.1 illustrates information collection required for operation planning.

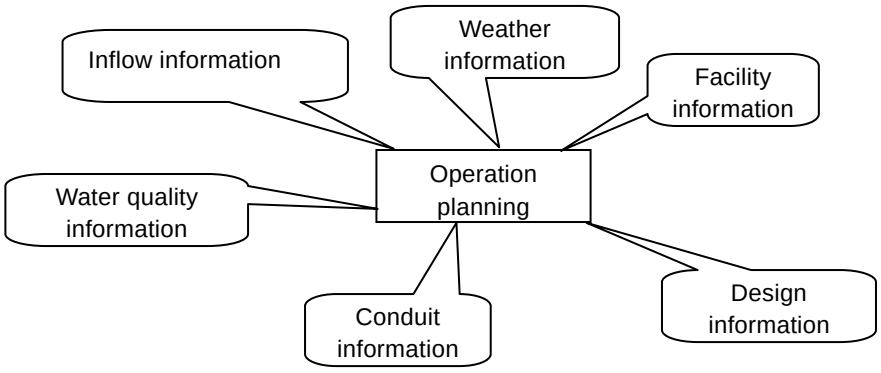


Fig.3.1 Information Collection for Operation Planning

3.3 Operations and water quality control

The operator changes settings for each instrument in order to comply with the operating conditions established in the operation plan. The water quality manager performs water quality analysis to check the outcome of treatment. This is repeated daily. The Table 5 provides management items in each process and what they represent.

3.4 Sludge treatment

The sludge treatment process treats highly concentrated polluted substances or waste material pulled out from sewage. As all stages in the process involve physical and chemical treatment except for the sludge digestion process, the treatment facilities

without digestion equipment facilitate stabilization (incineration, drying, etc.) of sludge as quickly as possible or transfer it out of the system.

3.5 Initial action

A treatment facility is designed so that inflow sewage can be treated when it reaches 100% of the design load after conduit facility development is completed. Therefore, as conduit development proceeds, the load (water quality * water volume) flowing in the treatment facility increases. It is needed to check the operating condition and coordinate the load applied on biological treatment facility including bypassing of the settling process and its capacity.

4. Maintenance and Management of sewer

4.1. General

Sewers which collect sewage and transport it to treatment plants or receiving waters are composed of sewers, manholes, outfalls, inlets, and laterals.

These facilities form a basic part of sewerage systems and are closely related to daily lives of inhabitants. So, actual states of the facilities should be fully grasped so that necessary maintenance and management may be appropriately carried out.

4.2 Objectives Of maintenance and management of sewers

The objectives of maintenance and management of sewers are listed as follows:

4.2.1) to secure flowing capacity,

4.2.2) to protect the facilities from damage by other civil engineering works,

4.2.3) to prevent accidents derived from damage of the facilities,

4.2.4) to prevent infiltration inflow, and

4.2.5) to extend practical service life of the facilities.

Unless the sewers are correctly maintained, soil may be accumulated in sewers and damage of sewers may be inflicted. Then, sewage overflowing, emission of odor, or subsidence of roads may follow in some cases. To prevent occurrences of such accidents, it is important to check for any inflow of sewage that may possibly damage the functions of pumping stations and treatment plants in addition to patrol and inspection of the sewers.

4.3 Outlines of maintenance and management

Conventional maintenance and management work has often been carried out as countermeasures taken when the worst state has occurred, such as suspension of

facilities function due to accidents: it is not taken for prevention of accidents but for coping with them only after they have actually occurred. However well - planned maintenance and management activities including preventive conservation of the facilities are needed for meeting the objectives of the maintenance and management work. Therefore, systematic maintenance and management which assure the most effective operation of the facilities are vital for attaining this goal.

The maintenance and management work is mainly composed of the following factors, and if we intend to carry it out regularly and effectively, we should in advance arrange and improve maintenance and management organizations, correctly hand over the facilities to assure smooth continuation of the work, reinforce safety and hygiene control, and assure diffusion of sufficient information to the public.

4.3.1) Inspection and research

4.3.2) Cleaning and dredging

4.3.3) Repairing of the facilities

4.3.4) Measures against disasters and accidents

4.3.5) Instructions of pretreatment facilities of industrial wastes discharged to sewerage systems and drainage facilities, and

4.3.6) Water quality tests at connecting points including treatment sub-districts in regional sewerage systems

4.4 General directions for maintenance work

All the members who are engaged in maintenance work of sewers should fully recognize that the maintenance work should be carried out smoothly, gaining the cooperation of inhabitants near the work site.

So, the general directions which are given to workers being engaged in the maintenance work of sewerage systems are listed as follows:

4.4.1) To conduct inspection and survey in a planned manner.

4.4.2) To establish maintenance work methods by giving top priority to assurance of workers' safety and health. Special attention should be paid to oxygen shortage, hazardous gases, combustible gases, and flowing water.

4.4.3) To gain full knowledge on conditions and functions of respective facilities, always make full use of the knowledge and experience, and make efforts to master and develop necessary techniques.

4.4.4) To gain inhabitants' cooperation by giving them full information on field work in advance. To take appropriate measures to prevent occurrence of traffic obstacles, noises, and odors. To act efficiently in close cooperation with colleagues while

securing the inhabitants safety.

4.4.5) To set up a system to take necessary measures promptly whenever inhabitants complaint, accidents or casualties occur.

4.4.6) To be prepared for an emergency by securing repair materials and checking and maintaining machines and instruments.

4.4.7) To get fully acquainted with laws and regulations concerned through daily activities.

4.4.8) To attempt to understand regional and social characteristics within the jurisdiction through daily activities.

4.5 Public Sewerage Register

4.5.1) Arrangement of public sewerage register

The Sewerage Law obligates a public sewerage register to be prepared and kept in custody and to utilize for public Perusal.

The register is needed for assuring appropriate management and accurate understanding of sewerage facilities and plays an important role as data for conducting maintenance and improvement work, making negotiations with other enterprises, and taking emergency measures.

The register is composed of records, drawings, and auxiliary documents.

The records describe brief history of sewerage work; types, shapes, and quantity of sewers and manholes; ground height and installation areas.

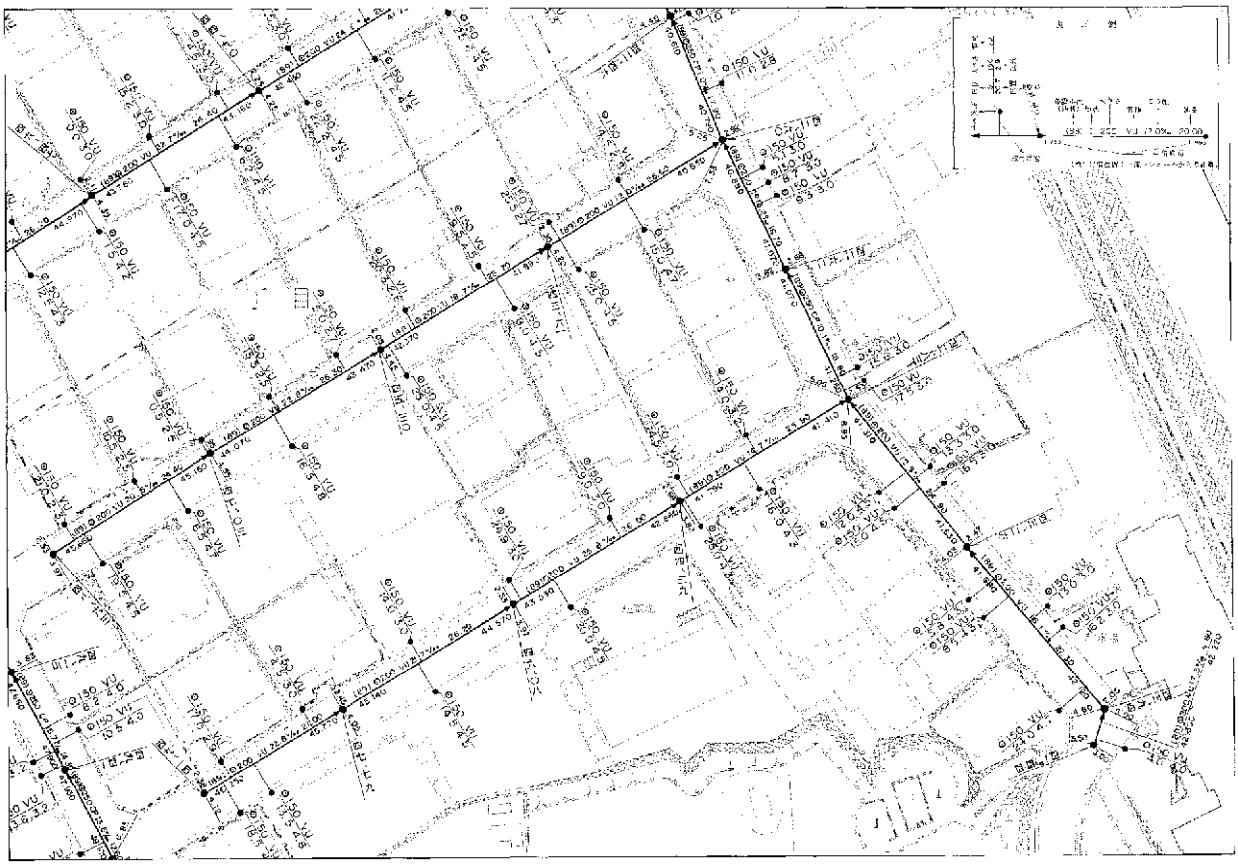


Fig.4.1 - Sample of Public sewer register

Processing Method by Process

Process Name	Control Item	Description	Possible Trouble
Settling basin	Flow rate	Too low: Deposition of organic matter	Deposition in the pump well
		Too high: Sand outflow	Wear of the main pumping casing
	Sand-elevating interval	To grasp the deposition amount	Deposition on the channeling conduit
			Wear of the Initial sediment-raking machine
			Wear of the initial sediment extracting pump
Screen	Cleaning	Screenings removal by cleaning	Odor generation
			Water level rise of the initial sewage reception tank
Pump well	Water level		
Initial settling basin	Movable weir adjustment	Even inflow to multiple basins	Airflow balance trouble
	Water area load	Settling efficiency	Aeration tank with high load
	Retention time	Settling efficiency	Aeration tank with high load
	Raking machine	Extracted sludge	Decomposition of deposited sludge
	Extraction interval	Operating efficiency of the extracting pump	Torque of the raking machine
Aeration tank	F/M	Drawing of sludge	Bulking and nitrification trouble
	Dissolved oxygen	Blower airflow	Discharged water quality
Final settling basin	Movable weir adjustment	Even inflow to multiple basins	
	Water area load	Settling efficiency	Discharged water quality
	Retention time	Settling efficiency	Discharged water quality
	Raking machine	Extracted sludge	
	Extraction interval	Operating efficiency of the extracting pump	
Disinfection tank	Retention time	Coliform bacteria count	Cost
	Residual concentration		Violation of law
Concentration tank	Retention time	Decomposition	
	Solids load	Concentration efficiency	
Anaerobic digestion tank	Digestion rate	Health of operating state	Dehydration performance
	Gas generation volume	Energy recovery	
	Density of input sludge	Digestion efficiency	
Dehydration facility	Water content	Dehydration performance	Affecting sludge disposal
	Chemicals added	Flock forming	Cost
Return water	SS concentration	Inflow load	
	Nitrogen concentration		

5. Procurement

Parts or consumables such as lubricants needed for maintenance of facilities, decontaminating chemicals and coagulants used for sludge dehydration must be kept in stock at any time. Excess stock is wasteful and shortage disables action in emergency. Thus, it is needed to maintain an appropriate level of inventory by estimating from manuals and the volumes consumed.

In particular, at a plant with facilities introduced from overseas, inventory management requires more intensive attention. The information shown in Table 5.1 on parts must be maintained in a well-organized manner.

Table 5.1 Example Table of Inventory Management

Process	Equipment	apparatus	Parts Name	Part No.	Replacement Frequency	Stock	Manufacturer	Delivery term	Supplier	Parson in Charge	Contact Phone No.
Pretreatment	Pumping station	Main Pump	Impeller	TK-220	5 years	2	Company A	3 months	Agency B	C.Dot	012-345-6789
			Bearing	BA-60	3 years	5	Company E	2 months	Company F	G.Hop	012-345-6790
			Gland Packing	100ϕ	2 month	10	Company I	2 weeks	Agency J	K.Loy	012-345-6791

Also, lubricant management is particularly important. Appropriate replacement practices control facility wear and help maintain the facilities in an optimal state over a long period. Lubricants and greases should used at the plant should be unified as much as possible. Table 5.2 shows an example of lubricant ledger.

Equipment Name	Location	Grease Name	Grease No	Greasing Month	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Simplified Dust Collector No.1	Settling basin plant	Lithium	No.2	Once in 6 months		○						○				
Simplified Dust Collector No.2	Settling basin plant	Lithium	No.2	Once in 6 months		○						○				
Scum separator	Settling basin plant	Lithium	No.2	Once in 6 months		○						○				
Sewage Pump No. 5	Settling basin plant	Albania	No.2	Once in 3 months		○			○			○			○	
Sewage Pump No. 6	Settling basin plant	Albania	No.2	Once in 3 months		○			○			○			○	
Sewage Pump No. 7	Settling basin plant	Albania	No.2	Once in 3 months		○			○			○			○	
Sewage Pump No. 8	Settling basin plant	Albania	No.2	Once in 3 months		○			○			○			○	
Screening hydro-extractor	Settling basin plant	Lithium	No.2	Every month	○	○	○	○	○	○	○	○	○	○	○	○

Table 5.2 Example of Lubricant Ledger

6. A day at a treatment plant

This section describes a typical workday at a plant along a timeline.

<table>
<tr><th>Time</th><th>Plant Manager</th><th>Maintenance Personnel</th><th>Quality Administrator</th><th>Operating Personnel</th><th rowspan="11">Visual-checking work</th></tr>
<tr><td rowspan="2">8:15～8:30</td><td colspan="4">Taking-over from night shift operators</td></tr>
<tr><td colspan="4">Confirmation of duty contents</td></tr>
<tr><td rowspan="2">8:30～9:00</td><td rowspan="2"></td><td>Confirmation of the day's work</td><td rowspan="2">Preparation for sampling and analysis</td><td>Preparation for the journa and daily reporting</td></tr>
<tr><td>Checking of tools and replacement parts</td><td>Preparation of checkup lists</td></tr>
<tr><td>9:00</td><td rowspan="3">Meeting with the consigner (the public office concerned)</td><td>Arrival at the site
Briefing at the site</td><td>Sampling</td><td rowspan="3">Checkup patrolling</td></tr>
<tr><td></td><td rowspan="3">Fieldwork</td><td rowspan="3">Water quality analysis</td></tr>
<tr><td>10:00</td><td>Operation change order to the operating department</td></tr>
<tr><td>12:00</td><td></td><td></td><td></td><td></td></tr>
<tr><td>13:00～13:10</td><td colspan="4">Confirmation of work in the afternoon</td></tr>
<tr><td>13:20～17:00</td><td>Consolidation of operation data</td><td>Fieldwork and creation of work report</td><td>Water quality analysis</td><td>Checkup patrolling</td></tr>
<tr><td>17:00～17:15</td><td colspan="4">End-of-the-day meeting/reporting and taking-over of duties</td></tr>
<tr><td>17:15～8:15</td><td colspan="3"></td><td>Night-shift watch</td></tr>
</table>

TEXT No.02

Outline of Sewage Works (Draft)

Version.1

HANOI SEWERAGE AND DRAINAGE COMPANY

Contents

1. Major Objectives of Sewerage Systems and New Tasks for Future

The purpose of sewage works is contribution to the sound urban development and enhancement of the public sanitation as well as conservation of favorable water quality in public water bodies.

There are mainly four principle objectives of sewerage systems.

1.1 Prevention of Flooding

1.2 Improvement of Surrounding Environment

- Immediate Removal of Rain Water and Wastewater
- Maintain of Public Hygiene

1.3 Instrument of Flush Toilets

1.4 Preservation of Water Quality in Public Water Bodies

Correspondent to principle objectives, following sewerage facilities are needed.

1.1.1 Wastewater transportation facility
- Sewer Systems

1.1.2 Pumping facility

1.1.3 Sewage Treatment facility
- Wastewater treatment Facility
- Sludge treatment Facility

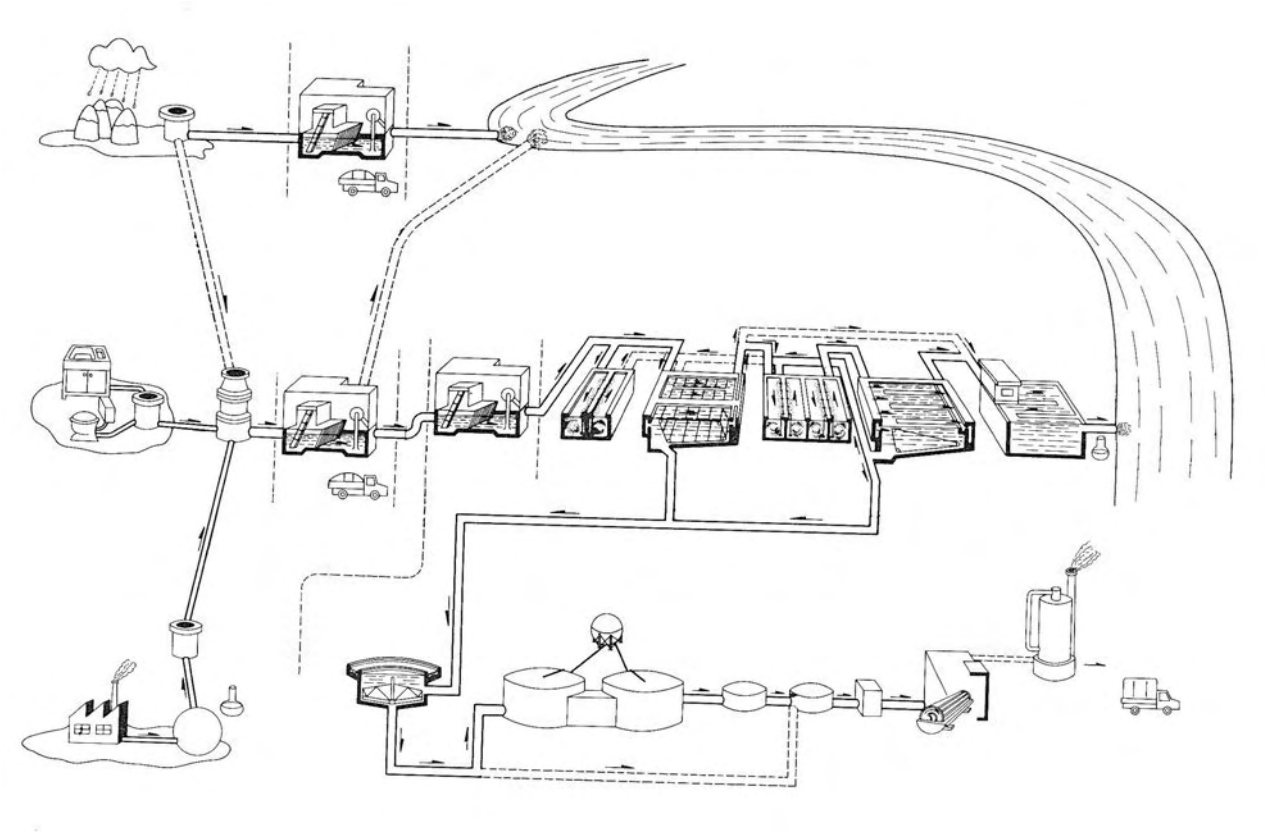
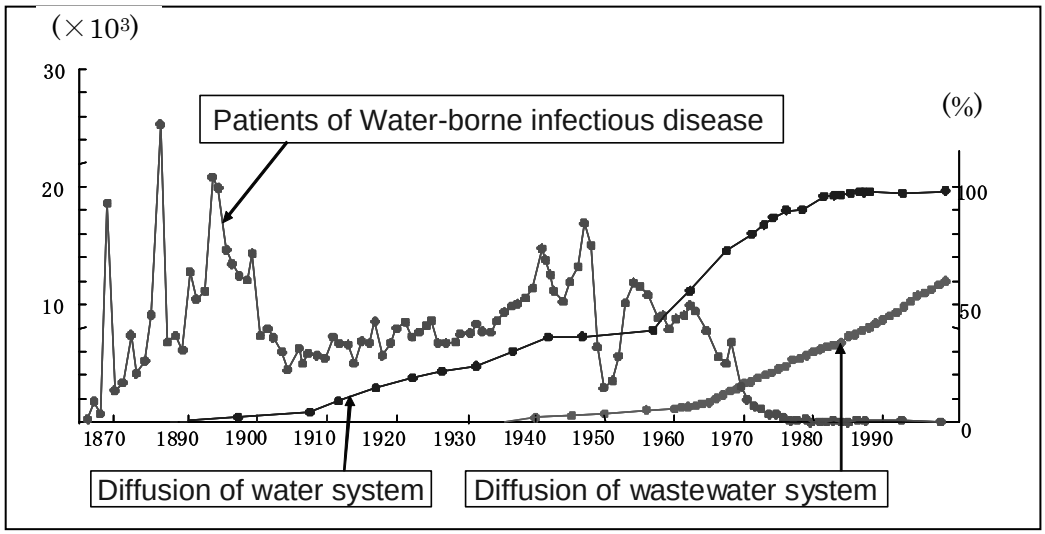


Figure-1.1 Structure of sewerage (Combined system)

2. Diffusion of Water and Wastewater system and Water-borne disease

It is important to reduce the number of patients suffering various diseases. This graph is indicated the number of patients and water and wastewater diffusion historically in Japan.



3. Situation of sewage works in Vietnam

In Vietnam, there are 5 sewage treatment plants. Now, several plants are under planning and constructions.
At fiscal year 2010, operation plants are as following;

Name	City	capacity	Treatment method
Truc Bach STP	Hanoi	2,300m3/day	A2O process
Kim Lien STP	〃	3,800m3/day	〃
Van Tri STP	〃	38,000m3/day	Activated Sludge process
Vinh Hung STP	Ho Chi Minh	141,000m3/day	Activated Sludge process
Vinh Hung Hoa STP	〃	30,000m3/day	Aerated Lagoon

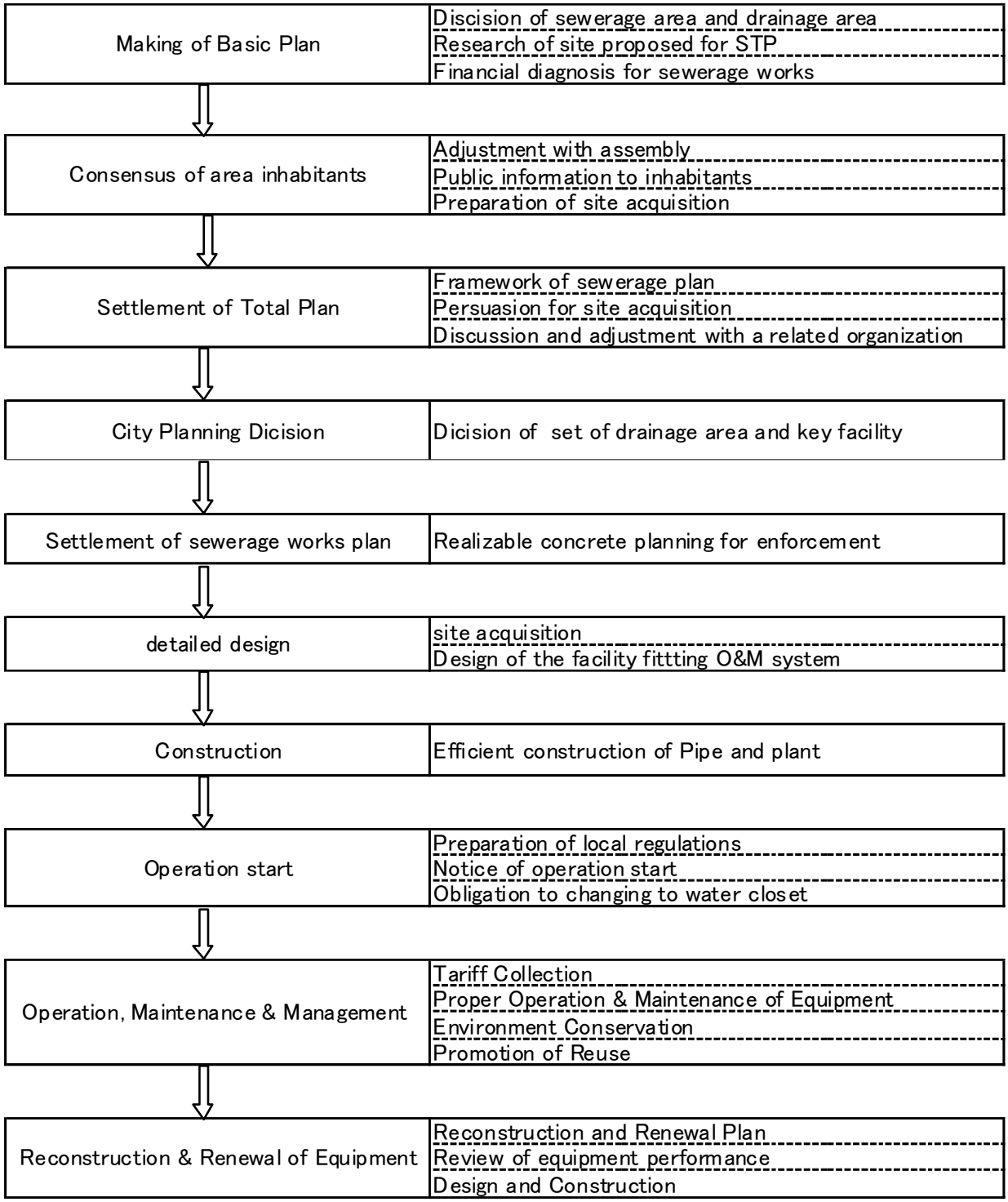
4. Domestic sewage (Unit of pollution loading)

In Japanese case, this table shows a quantity and quality of sewage per one person in human life. This value becomes one of grounds when planner predicts a quantity of load of the sewer.

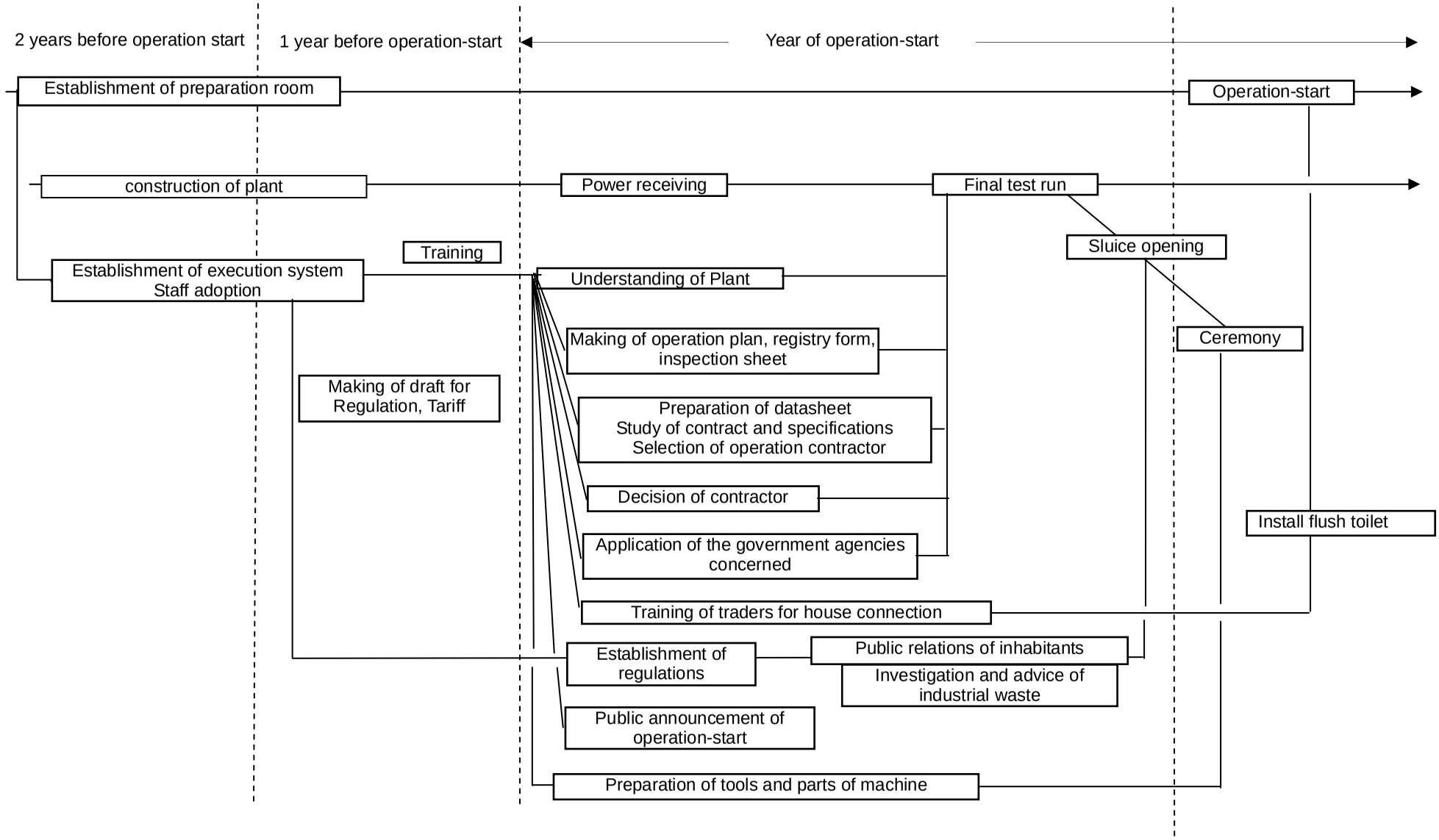
	Quantity (L/p-day)	BOD		T-N		T-P	
		Unit (g/p-day)	quality (mg/L)	Unit (g/p-day)	quality (mg/L)	Unit (g/p-day)	quality (mg/L)
Total sewage	**250**	**45**	**180**	**8.5**	**34**	**1.0**	**4.0**
Non-fecal wastewater	200	29	145	1.5	7.5	0.3	1.5
Human excreta	50	16	320	7.0	140	0.7	14

5. How to promote the Sewage Works

Sewage works is almost promoted in the following procedure by related organizations.



In particular, recent two year to Operation-start is showed figure-“FLOWCHART”



< Flowchart to Operation-start >

A-134

6. Sewage Works and Publicity Activities

6.1 Importance of Publicity Activities

For good administration it is important to tell the people the plans and their objectives as well as the conceivable impacts of the plans on the community and people's living. Through such activities the administration should help form people’s understanding and consensus on the plans. The administration should understand the importance of this aspect particularly with respect to sewage works in which people have to bear the cost.

The sewage works are essential for improving the living environment and to prevent inundation, or to realize safe and comfortable city life. In future the administration will be expected to do further to restore comfortable water environment in which people could find relaxation and richness and also expected to address new challenges to effectively utilize the sewage resources and assets.

Despite such important roles of the sewage works, their presence and roles tend to be disregarded by people because of their invisibility. With the flush toilets becoming as a matter of course, people’s consciousness of the sewage works which used to be connected with comfort of the flush toilets may change.

Under such a circumstance, the administration should promote publicity activities on the following to obtain people's understanding and cooperation, an essential factor for smooth implementation of the sewage works.

6.2 Traditional roles of the sewage works

- Improvement of living environment
- Prevention of inundation

6.3 Future objectives of the sewage works

- Restoration of comfortable water environment
- Effective utilization of sewage resources

6.4 Sharing by the people of the cost of sewage works

- Sharing by the people of the burden of long construction periods and cost

6.5 Importance of Public Hearing Activities

It is true that one of the important functions of publicity activities is to arouse people’s interest in sewage works. Before sending a certain message to the people the administration should know people’s interest and their views on the sewage works.

It is often pointed out that there is a wide gap between the information the administration provides and that the people want. The publicity activities and public hearing activities should basically go hand in hand. The administration should be as eager to hear the opinion of people as to promote its policy objectives in order to how exactly what people want to know and to spread the kind of information people want. Even if an administration does not have a formal system of public hearing, the administration could take advantage of every opportunity to contact people in order to collect people’s opinions.

The administration should take every opportunity to hear the opinions of people in order to be able to promote effective public relation activities, which should not be inclined merely to spread information from the side of administration.

TEXT No.03

Maintenance of Machinery of Pumping Station and Sewage Treatment Plant

Version.1

HANOI SEWERAGE AND DRAINAGE COMPANY

Contents

1. Mechanical Equipments and Instruments

Basic flow diagram

The basic flow diagram of Sewage Treatment Plant is shown in Fig. 1.

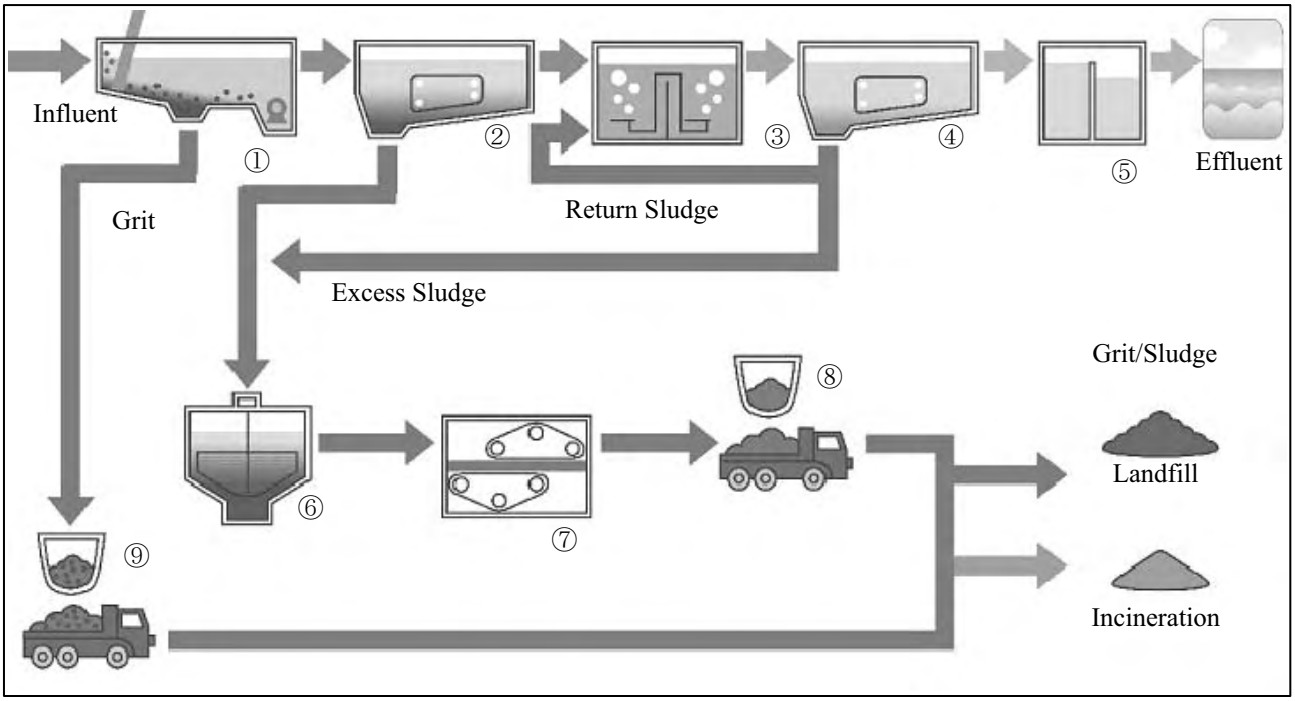


Fig. 1 Sewage Treatment Plant Flow Diagram
(Conventional Activated Sludge Process)

Purpose and Basic equipment/instrument for each part of facility are followings.

1.1 Pumping station / Grit chamber

Purpose

- Remove grit in the influent
- Lift up waste water to sewage treatment plant and/or primary settling tank

Basic equipment and instrument

- Gate
  - Control the number of grit chamber in operation
  - Make possible the inspection and maintenance of grit chamber
  - Prevent inundation of grit chamber room

- Screen
  - Remove matters that may damage the equipment
  - Remove matters that may obstruct the satisfactory operation of treatment process and equipment
  - Remove matters that may disturb the satisfactory state of the discharge water

Screen is classified in two types according to the clearance

Coarse screen

This screen has a large clearance, approximately from 75mm to 100mm in Japan, to remove rag, debris, etc. In general, this screen is operated by hand.

Fine screen

This screen has a small clearance, approximately from 20mm to 50mm in Japan, to remove small garbage in sewer that coarse screen can't remove. In general, this screen is operated by electricity.

- Grit collector
  - Remove grit in sewer to prevent the troubles mentioned below
    - Abrasion of mechanical equipment
    - Obstruction of pipes
    - Sedimentation of grit in settling tanks and digestion tanks
  - Grit collector is installed to facilitate the removal work and keep the condition of grit chambers clean

- Lift pump (Transfer pump)
  - Lift up (transfer) wastewater to Sewage Treatment Plant and/or Primary Settling Tank
  - In general, this pump is submersible and operated in water

- Inlet Conduit Level (Float Switch and/or Level Meter)
  - Alarm high water level to prevent inundation
  - Close inlet gate automatically with the alarm of water level (sometime)

- Influent Pit Level (Float Switch and/or Level Meter)
  - Alarm high water level to prevent inundation
  - Alarm low water level to prevent the break of equipment
  - Control pumps automatically to lift up wastewater

1.2 Primary Settling Tank

Purpose

Remove the suspended solids by gravity settling

Basic shape

- Rectangular
- Circular

Basic equipment and instrument

- Sludge collector
  - Collect sludge accumulated at the bottom of tank
- Pipe skimmer
  - Remove scum
- PST Sludge Pump
  - Draw raw sludge to Sludge Thickener Tank
- PST sludge flow meter
  - Indicate PST sludge flow and/or count amount

1.3 Reactor

Purpose

Main equipment of biological treatment

Basic equipment and instrument

- Blower
  - Blow air into the reactor tank
- Air Diffuser
  - Make small bubble air to increase contact area between air and waste water
- DO meter
  - Indicate DO value in the reactor tank
- MLSS meter
  - Indicate MLSS value in the reactor tank

1.4 Final Settling Tank

Purpose

Remove the suspended solids by gravity settling

Basic shape

- Rectangular
- Circular

Basic equipment and instrument

- Sludge collector
  - Collect sludge accumulated at the bottom of tank
- Pipe skimmer
  - Remove scum
- Return Sludge Pump
  - Draw sludge from FST to Reactor
- Excess Sludge Pump
  - Draw sludge from FST to Sludge Thickener Tank
- Sludge Concentration meter
  - Indicate Sludge Concentration value
- Return Sludge Flow Meter
  - Indicate Return Sludge Flow value
- Excess Sludge Flow Meter
  - Indicate Excess Sludge Flow value and count amount

1.5 Disinfection Facility

Purpose

Disinfect effluent water by injecting chemicals (sodium hypochlorite, etc) into

Basic equipment and instrument

- Chemical tanks
  - Store chemicals
- Chemical dosing pump
  - Pour chemicals into
- Effluent Turbidity meter
  - Indicate turbidity of effluent water
- Effluent Flow meter
  - Indicate effluent flow and/or count amount

1.6 Sludge Thickener

Purpose

Settle sludge by gravity settling

Basic shape

- circular

Basic equipment and instrument

- Sludge Thickener Tank
  - Thicken Sludge by gravity
- Thickened Sludge Scraper
  - Collect Thickened Sludge
- Sludge Transfer Pump
  - Transfer thickened sludge to Sludge Hopper
- Sludge Tank Level Switch and/or Meter
  - Alarm high water level
  - Control sludge transfer pump automatically

1.7 Dehydrator

Purpose

Decrease moisture content of sludge

Basic equipment and instrument

- Dehydrator
  - Main equipment
- Chemical (polymer etc) tank
  - Store chemical that accelerates to decrease moisture content
- Chemical dosing pump
  - Pour chemicals into Dehydrator
- Chemical tank level (electrode)
  - Alarm the low water level of chemical tank
  - Control chemical dosing pump automatically

1.8 Sludge Hopper

Purpose

Store sludge until being carried out

Basic equipment and instrument

- Hopper
  - Store sludge

Hopper Weight meter

- Alarm heavy load to stop sludge transfer pump

1.9 Grit Hopper

Purpose

Store grit until being carried out

Basic equipment and instrument

- Hopper
  - Store grit
- Hopper Weight meter
  - Alarm heavy load to stop grit collect/transfer equipments

2. Electric Equipments

2.1 Power Receiving

Purpose

To receive the power for the STP/PS

Basic equipment and instrument

- Power Receiving Panel
- Meters (Voltage, Current, Power-factor, etc)
- Protective relays

2.2 Transformer

Purpose

To transform from high voltage (11kV or 22kV) to low voltage (400V or 200V)

Basic equipment and instrument

- Panel
- Transformer

2.3 Distribution Panel

Purpose

- To distribute to the power for load and/or lighting circuit
- To cut the power by protective relay in power trouble and alert
- To check the usage of electric energy by watt-hour meter

Basic equipment and instrument

- Distribution panel
- Circuit breaker

2.4 Generator

Purpose

- To supply STP/PS with the power when power stops
- Start automatically when power stops

Basic equipment and instrument

- Generator
- Auto start/stop panel
- Auto switching panel

2.5 Control Panel

Purpose

- To control equipments automatically
- To install Auto control circuit
- On/off control by manual
- To alert facility trouble

Basic equipment and instrument

- Control panel
- Circuit breakers
- Relays
- Timer switches
- Change over switches
- Change switches

2.6 Supervisory Panel

Purpose

To supervise facility status totally

Basic Items are…

- Equipment status
- Alarm

- Instrument (flow, water level, etc)
- Flow amount

2.7 Monitoring Equipment

Purpose

- To supervise facility status and condition by PC monitor
- To log facility data

Basic equipment and instrument

- PC
- Monitor
- Printer

3. Maintenance

3.1 Purpose

Purpose of Maintenance is to keep the facility function stable. Therefore, it is very important to consider maintenance plans in order to keep the facility function stable.

3.2 Why need to maintain equipments?

Because, equipment start deteriorating when it is installed as shown in Fig.3.1. So, it's very important to prolong equipment life-time. To achieve prolonging equipment life-time, it's necessary to build the efficient repair/replacement plan and to record the check result historically.

These activities are achieved by appropriate O&M works. Therefore, O&M works is very important.

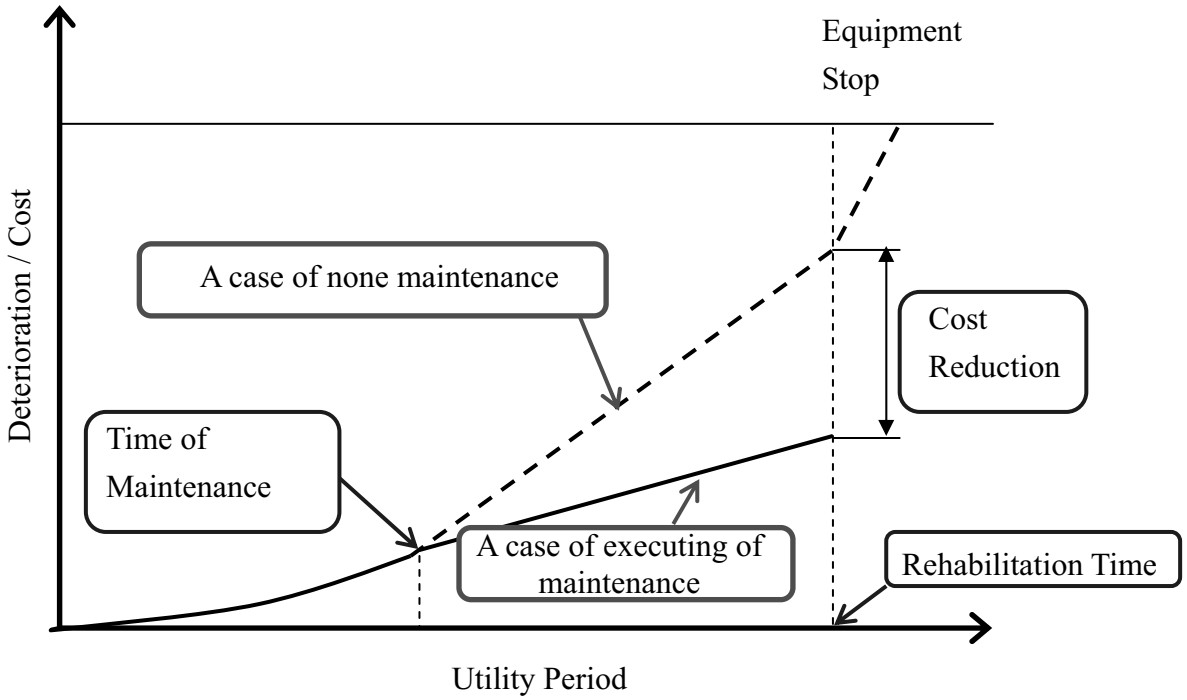


Fig.3.1 Cost reduction through Preventive Maintenance

On the other hand, Maintenance activities need the huge cost. If, a very important and/or an expensive equipment is broken, the total maintenance cost (repair cost, recovering bad effluent water quality cost, etc) becomes far more expensive than expected.

To achieve cost reduction through Preventive Maintenance, it's necessary to build Efficient and Effective Maintenance Management.

* Rehabilitation Time: the time to consider the replacement of equipment

3.3 Efficient and Effective Maintenance Management

3.3.1 Asset Management and Stock Management

For Efficient and Effective Maintenance Management, There are two approaches: "Asset Management" and "Stock Management".

These two approaches have the same goal that is to prolong equipment. But, there is the difference following below.

Asset Management is a thinking from the view of owner. Facility owner has to consider systematic maintenance plan to increase the public benefit with long-term facility (asset) management.

On the other hand, Stock Management is a thinking of the view of O&M. For Stock

Management, it is very important to collect the current situations of facility, such as equipment inspection, maintenance, monitoring, operation, daily check, clean-up, repairing, to achieve an efficient maintenance planning and the implementation.

3.3.2 Maintenance Management

In Japan, Maintenance Management is categorized as shown in Fig.3.2.

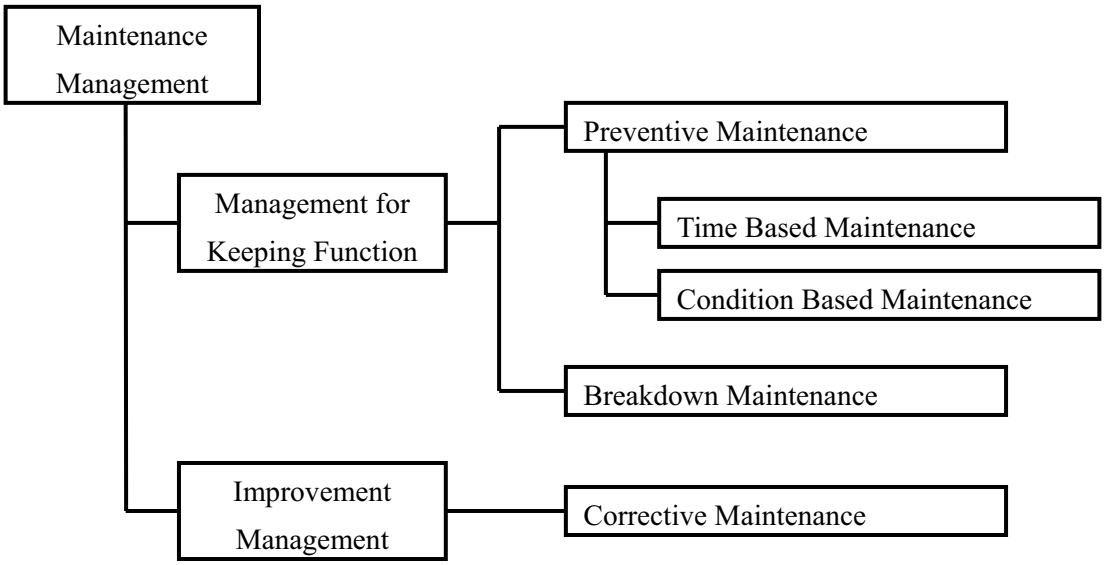


Fig.3.2 Maintenance Management

Here, Considering of Management for Keeping Function.

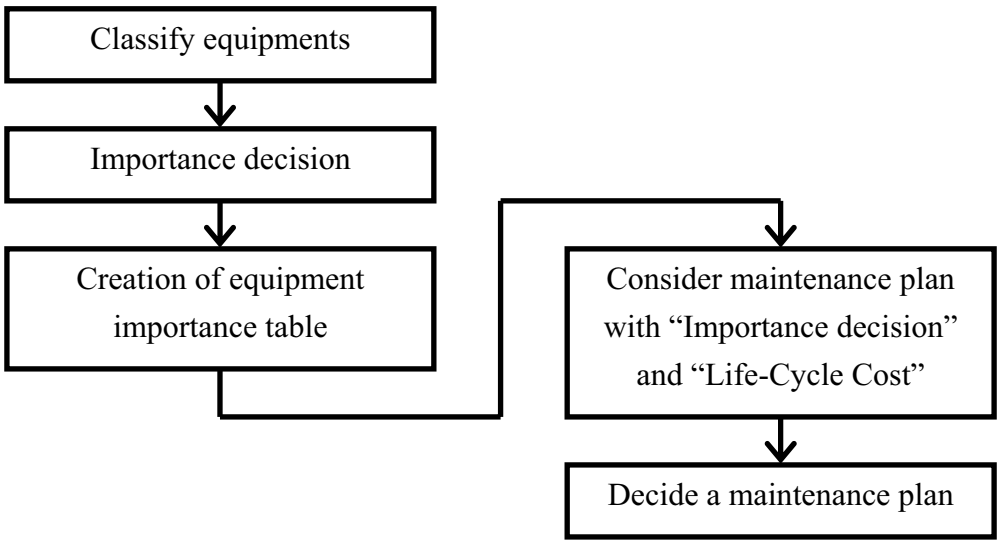
At first, for deciding maintenance plan, classify the equipment. After that, equipment importance will be decided by the following items.

- influence to facility function
- spare equipment
- repair cost

Sometimes, we need to consider of required regulation.

In general, importance decision will be the base of building the Maintenance plan.

Here is concrete method to approach a maintenance plan below.


Classify equipments
Importance decision
Creation of equipment importance table
Consider maintenance plan with “Importance decision” and “Life-Cycle Cost”
Decide a maintenance plan

And, example of equipment table is shown in Table 3.1.

Table 3.1 Equipment importance table

Classify	Equipment	Influence to Facility Function	Spare Equipment	Repair Cost	Importance Decision	Regulation
Mechanical	Inflow Gate	Normal	No	High	A	-
Mechanical	Screen	High	No	High	A	-
Mechanical	Lift Pump	High	Spared	High	A	-
Mechanical	Primary Sludge Scraper	Normal	No	High	B	-
Mechanical	Aeration Blower	High	Spared	High	A	-
Mechanical	Final Sludge Scraper	Normal	No	High	B	-
Mechanical	Return Sludge Pump	Normal	Spared	Low	B	-
Mechanical	Excess Sludge Pump	Normal	Spared	Low	B	-
Mechanical	Dehydrator	High	No	High	B	-

- Life-Cycle Cost

For long-term cost reduction, Life-cycle cost is a very useful approach as shown in Fig.3.3.

If replacement cost is higher than repair cost, repair the equipment when the function is deteriorating around standard level as shown in Fig.3.4.

Otherwise, if repair cost is higher than replacement cost, replace the equipment after breakdown as shown in Fig. 3.5.

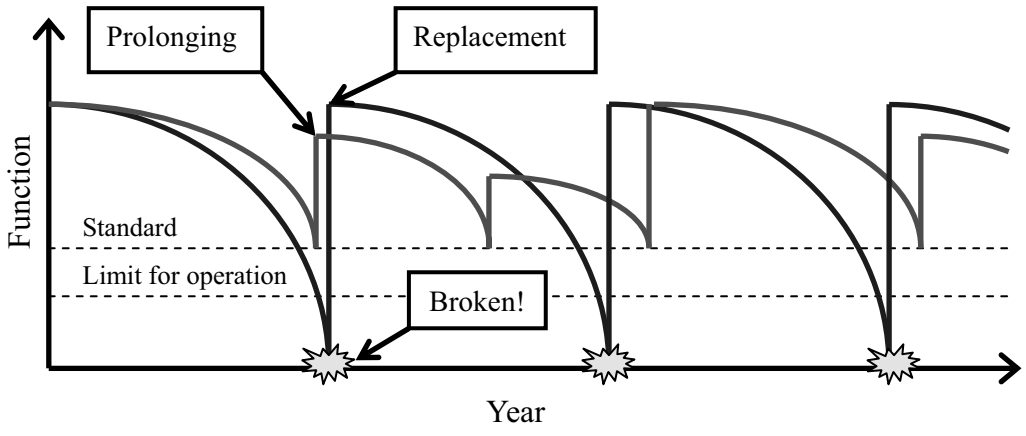


Fig.3.3 Life Cycle Cost

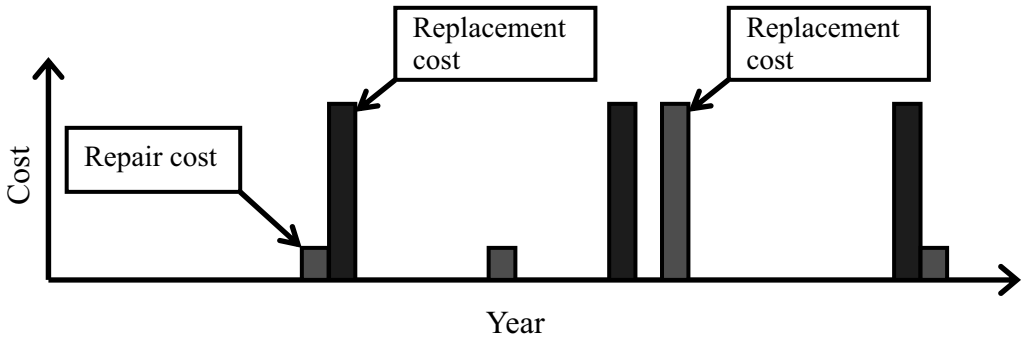


Fig.3.4 A case of higher Replacement Cost

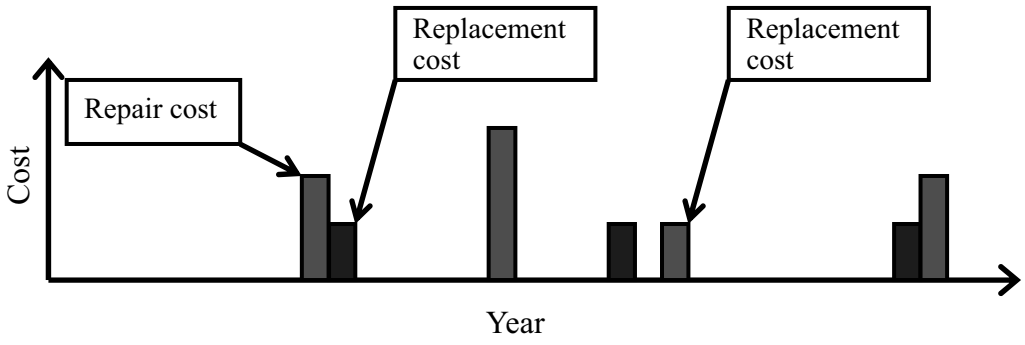


Fig.3.5 A case of higher Repair Cost

- Decide a maintenance plan

  To decide preventive or breakdown maintenance due to equipment importance decision and life-cycle cost.

  - Preventive Maintenance

    Preventive Maintenance method will be applied the equipment that is lower maintenance cost than the repair one.

    Preventive Maintenance is classified with two types as followings.

    - ✧ Time Based Maintenance

      To decide repair a period based on operation (run) time. It's easy to make a repair plan. However, it's easy to become taking a lot of maintenance cost because repair an equipment before break down.

    - ✧ Condition Based Maintenance

      To decide a maintenance plan based on qualitative and/or quantitative checked condition. For example, abrasion, vibration check, oil/grease check and so on. This maintenance method is very useful to prevent

maintenance cost increasing.

- Breakdown Maintenance

  This method is to repair equipment after breakdown without periodic condition check. It's easy to apply the equipment that is low importance in sewage treatment plant and/or repair cost is lower than the maintenance one.

3.3.3 Improvement Management

This is the method to improve equipment after breakdown.

Improvement Management also has two types as followings.

- Corrective Maintenance

  This is an improvement method of the equipment. After analysis of equipment trouble, if it would be caused by the equipment structure, shape or specification, needs to improve/change the equipment.

- Maintenance Prevention

  If finding out some weak points on the equipment, feed back to the manufacture about it. It will be useful to achieve low maintenance cost by the equipment improvement.

○ Relationship between deterioration of the facility and maintenance technology

Through management, a facility approaches a state of optimal maintenance, preparing for retention of its functionality for a longer period. Regular repair practices help rehabilitate to some extent but cannot fully restore its initial performance. So deterioration develops. Also, during the operation period, facilities of the same model often continue to show improved functionality thanks to technological advancement. This is relative deterioration that is not directly associated with maintenance to make the facility obsolete. In this case, renovation of the facility can achieve functional recovery of the facility. Fig. 3.6 shows a relationship between functional deterioration and equipment maintenance and a Table 3.2 shows standard service life as a reference.

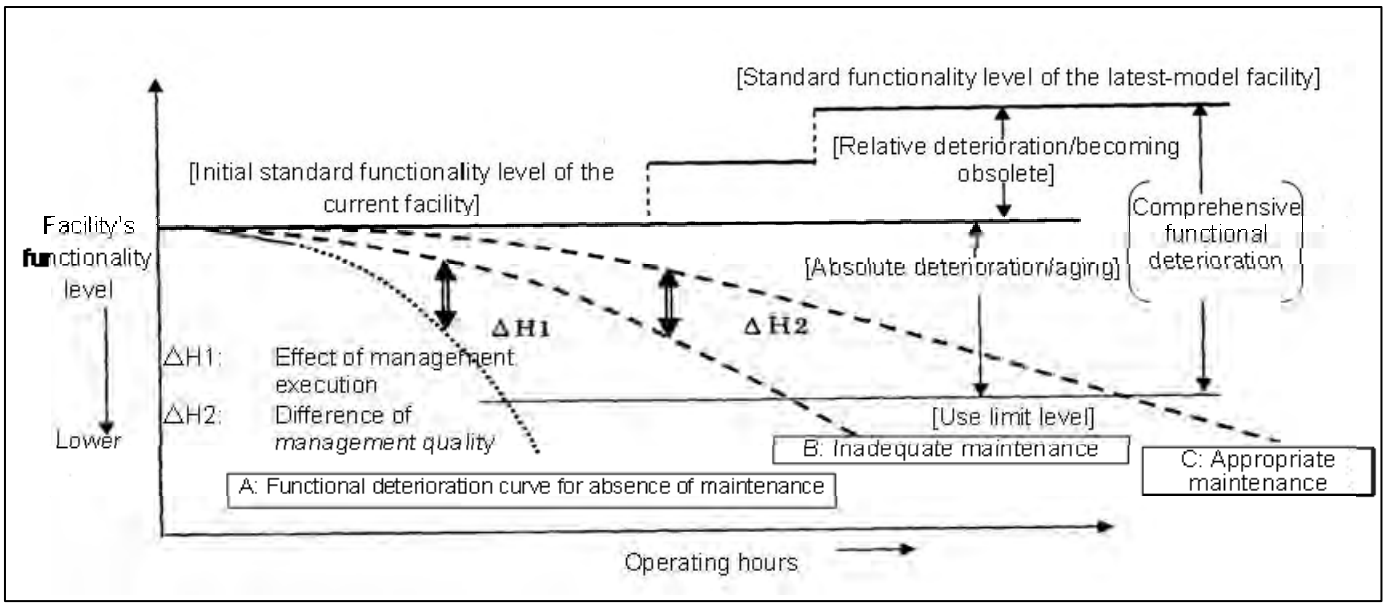


Fig. 3.6 Relationship between Functional Deterioration and Equipment Maintenance

Major classification	Medium classification	Minor classification (Target facility)	Durable Years
Water treatment facility	Initial settling basin facility	Inflow gate	17
		Sludge raking equipment	17
		Reducer facility	
		Pipe skimmer	
		Scum separator	
		Sludge pump	15
	Aeration facility	Inflow gate	17
		Blower main body	20
		Motor	
		Discharge valve	15
		Backflow stop valve	

Table 3.2 Standard Service Life in Japan

3.3.4 Record

After check/inspection, it's very important to record these result historically, because these check/inspection results will be the base of revising a maintenance plan. Record items will be followings.

- Machine run time record
  This record is based on "Time-based preventive Management".
- Machine trouble historical record
  This record is based on "Improvement Management".
- Machine condition historical record
  This record is based on "Condition-based preventive Management".

Fig. 3.7 Example of Ledger

3.3.5 Others

There are also important things to keep the facility function stable

- Clean up period (machine)
- Calibration period (instrument)
- Test run planning
- Report system in trouble situation
- Keeping maintenance space

3.3.6 Daily check and Periodical check

- Daily check

  In general, daily check is quantitative and conducted by the senses. For example, listening, seeing, touching, and smelling. Daily check is very important to notice some problem by comparing usual condition.

  Daily check items will be followings.

  - Noise — Check by listening. If some problem occurred, it must be noisier than usual.
  - Overheated — Check by touching. If some problem occurred, it must be hotter than usual.
  - Vibration — Check by touching and listening. If some problem occurred, it must vibrate bigger than usual.
  - Smell — Check by smelling. If some problem occurred, it must smell something burnt.
  - Visual — Check by seeing. If some problem occurred, something happened, for example, notice some crack, loosen bolts, color changing, etc.

- Periodical check (Annual check)

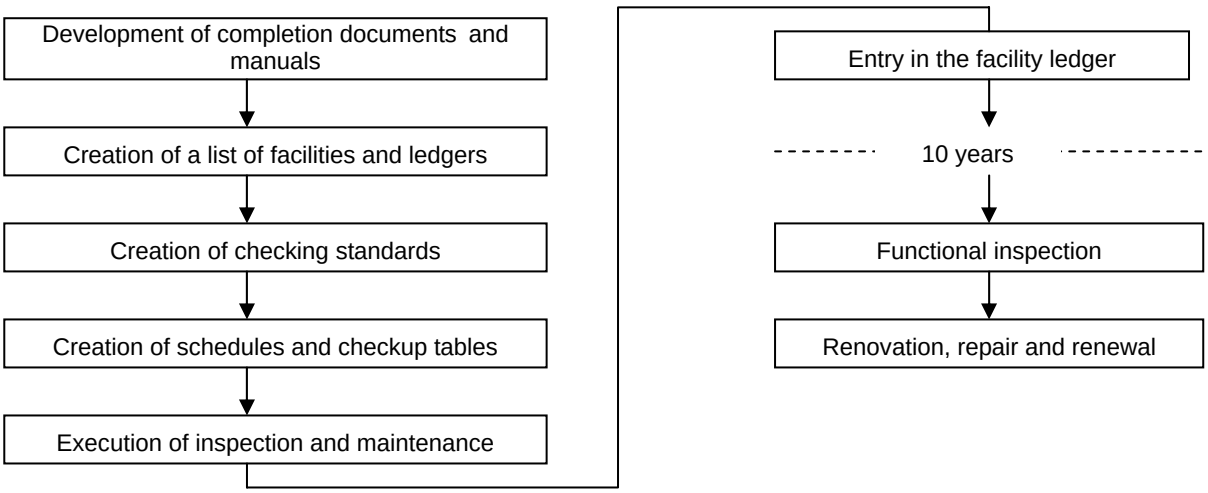
  In general, periodical check is quantitative and conducted by measuring. Periodical check items will be followings.

  - Current (Each equipment)
  - Insulation resistance (Each equipment Especially, submersible)
  - Discharge pressure (Pump, Blower)

4. How to approach the Maintenance plan

In facility management, maintenance is a most fundamental act for maintaining the continuity of the treatment plant. Therefore, regardless of the plant size, maintenance must be securely structured. Normally, the framework of the maintenance procedures is determined at the dry-run stage before the completion of the construction of the treatment plant. The following shows a flow of tasks in the maintenance plan development process, followed by step-by-step description.

＜Maintenance flow＞



4.1 Development of completion documents and manuals

Facilities to be installed are often from overseas manufacturers and the manuals are written in English. Actually, as the users of the manuals are maintenance engineers, the most essential requirement for manuals is that they are written in their native language. It is critical for the facility suppliers to always satisfy this requirement.

4.2 Creation of a list of facilities and ledgers

Classify the facilities into three levels or so. After creating a list of facilities, create ledgers. After creating the ledgers, manage all facilities using the ledgers.

4.3 Creation of checking standards

In Japan, two methods are used for determining facility checking items and frequencies:

- Create a table of checking standards by referring to examples of general checking

items and frequencies.

○ Create a table of checking standards by referring to maintenance and inspection items in the manuals and inspection frequencies.

Table 4.1 shows an example of a general checking standard table.

4.4 Creation of checkup schedules

According to the checking standard table, create an annual schedule. Based on the annual schedule, create monthly schedule. Also, based on the checking standard table, create a list of checkup records (check lists). Table 4.2 shows a checkup schedule example and Table 4.3, an example of a list of checkup records.

* The ledgers and tables mentioned above are available as the system automatically creates them in a commercial database software application or spreadsheet software.

4.5 Functional inspection and renovation/repair/renewal

Facilities naturally deteriorate as certain length of time elapses after the commencement. Generally, the service life is represented in durable years, which indicates reference timing for renewal of the facility and equipment. The length of period for which the specified functionality is maintained varies depending on the operating environment and how it has been maintained. Therefore, after a certain number of years (10 - 15 years), it is checked to see if the equipment within a facility is still fully functional.

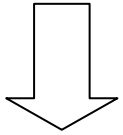
This section only describes the conceptual aspects of this topic, omitting the details.

Facility Category	Type Category	Daily Checkup	Method	Instrument	Monthly Checkup	Method	Instrument	Quarterly/ Semiannual Checkup	Method	Instrument	Annual Checkup	Method	Instrument
Blower facility	Blower (Turbo type with horizontal shaft directly connected to the motor)	1. Checking for abnormal noise, vibration and heat when running	B	-	1. Checking of lubricant state	A	-				1. Measurement of insulation resistance	-	c
		2. Checking of pressure gauge values for suction and discharge	A	-	2. Checking of contamination/damage state of the main body and piping	A	-						
		3. Checking of ammeter values	A	-	3. Checking of contamination/wear state of the brushes	A	-						
		4. Checking of thermometer values for the shaft	A	-									
A	(Multi-step single-suction type directly connected to the motor)	5. Checking of suction airflow	A	-	4. Checking for deterioration and wear of coupling bushings	A	-						
		6. Checking of lubricant amount for bearings and leakage	A	-	5. Measurement of vibration on each bearing section	-	d						
		7. Checking of indicator and operation lamps	A	-									
Code for checking method		A: Visual B: Contact or listening C. Measurement											
Code for devices used		a: Grease gun/application, b: Slide gauge, c: Insulation resistance tester, d: Vibration gauge, e: Central oiler, f: Measure, g: Tester h: Thermometer, i: Density meter, j: Ohm meter for ground resistance, k: Relay tester											

Table 4.1 Example of Checkup Standards Table for Mechanical Facilities

Annual Schedule for Facility Checkup

Facility	Equipment Name	April	May	June	July	August	September	October	November	December	January	February	March
Settling basin	Inflow gate	① ⑫	①	①	①	①	①	①	①	①	①	①	①
	Automatic dust collector	① ⑫	① ⑥	①	①	①	①	①	① ⑥	①	①	①	①
	Screenings hydro-extractor	① ⑫	① ⑥	①	①	①	①	①	① ⑥	①	①	①	①
Legend for frequency code: (1) Monthly checkup (2) Quarterly checkup (3) Semiannual checkup (4) Annual checkup													



Regular Checkup Schedule for May

Equipment Name	Planned Checkup	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
		TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED
Inflow gate	①									①																					
Automatic dust collector	①⑥								①															⑥							
Screenings hydro-extractor	①⑥										①														⑥						
Remarks:																															

Table 4.2 Examples of Monthly/ Annual Checkup Schedule

Regular Checkup Recording Table for Water Treatment Facility and Equipment

Facility Name: Grit Chamber Facility			Inspection date		4／	5／	6／	7／	8／	9／	10／
Checkup items		Equipment name	Model No.	Checker / Reference value							
Checking for abnormal noise, vibration and heat from the reducer Checking for wear ad damage of the blades Checking for loosened bolts and nuts (As needed) Grease supply (Annually) Replacement of reducer oil	Checking frequency: Monthly	Screenings crushing machine	1 15kw	26.6A or less							
			2 7.5kw	14.8A or less							
Checking for chute clogging Checking of the screw state Checking for abnormal noise and vibration from the reducer (Annually) Oil replacement of the reducer Oil replacement of the hydraulic unit		Screenings hydro extractor	—	—							
		Hydraulic unit	—	—							
Checking for abnormal noise and vibration from the drive Checking for abnormal noise, vibration and heat from the reducer		Grit separator	—	—							
Checking of the pressure gauge indicator Checking for nozzle clogging Checking for abnormal noise and vibration from the drive		Screenings/grit conveyor	—	—							
State Code	Upper row	レ: Normal A: Damaged or soiled B: Broken C: Abnormal noise D: Abnormal smell E: Overheat F: Vibration G: Wear H: Corrosion J: Leakage L: Clogged M: Insulation failure N: Indication failure P: Malfunction									
	Lower row	◎: Cleaning ×: Replacement □: Repair △: Adjustment ○: Others I: Severe failure (cannot recover with action II) II: Medium-level failure (Recoverable with simple parts replacement or working) III: Minor failure (recoverable with cleaning or adjustment) IV: Others									

Table 4.3 Example of Checkup Recording Form (Regular Checkup List)

A-160

TEXT No.04

Water Quality Control

Version.1

HANOI SEWERAGE AND DRAINAGE COMPANY

Contents

1. Generals

Objective of water quality management

Water quality tests for sewerage are implemented to maintain water and sludge treatment facilities appropriately, or to verify that effluents and sludge from such facilities conform to the law and regulations. The water treatment facilities, when maintained appropriately, enable to produce good effluent and to improve the water quality and water front environment in the public water bodies.

Under the legal tests, the effluent shall be measured for the items provided by the Water Pollution Control Law and the Sewerage Law. However for the purpose of maintenance and survey, analysis must be made considering to the given situation.

Therefore, it is desirable hat he manager of water quality possesses the knowledge to judge what kind of analysis is possible for the situation.

2. Items of water quality test

2.1 Kinds of Water quality tests

The water quality test can be divided as follows according to purpose;

2.1.1) Test for discharging treated water of good quality
2.1.2) Test of effluent according to the law(legal examination)
2.1.3) monitoring test
2.1.4) Other tests

2.2 Test for discharging treated water of good quality

This category mainly includes water quality tests to maintain water and sludge treatment facilities in good state. In other words, the test is to check whether or not each facility is appropriately operated and managed, and whether the effluent is good or bad in quality, with the following kinds of tests.

Daily test : Test for daily management of water treatment facilities; this kind of test is simple and implemented at fixed hours every day for the items of water temperature, pH, COD, etc.

Semi-detailed examination of water quality : comprehensively grasps the quality of effluents and treated waters. This examination is composed of a daily test, plus BOD,SS etc.

Precision test : this is a semi-detailed examination, but adding checking heavy metals, pesticide chemicals, volatile organic compounds, etc. The test results of effluents can

be used as a data for legal examination.

Diurnal examination of water quality : samples are taken at certain intervals and examined, considering the volume and quality of influent and effluent at the treatment center as well as actual operational status.

Preferably, the examination of water quality should be made immediately after sample-taking. But when determining average concentration and load, it is necessary to carefully store mixed samples in cooled status.

2.3 Test of effluent according to the law (legal examination)

This examination is mandatory by the Sewerage Law and the Water Pollution Control Law to check whether or not the quality of effluent meets the standard. Measurement shall be made at a predetermined mandatory frequency, and the results recorded and stored.

Results of the mandatory examination can be used as data for the maintenance of water treatment facilities.

Key laws and regulations of the sewerage are as follows:

Sewerage Law

This law covers not solely the items for development of sewerage, but also the water qualities of effluents from the sewerage to the public water bodies and of influents to the sewage treatment plant.

Standards for influents

The current sewage treatment plant is designed, as a main purpose, to remove organic matters, and not able to treat the sludge containing heavy metals, and difficult to treat organic pollutants of high concentration. Therefore, the standard provides the requirement for influents.

Water pollution control law
This law specifies the quality criteria of waters discharged from legally designated business establishments to public water bodies, or of waters going into the ground.
There are two kind standards of wastewater : the first is the universal standard and the second a bylaw-based additional standard which is applied to municipally designated water bodies.

At Japanese case, standards are divided for health items and living environment items. The standards for health items are applied to all the designated business establishments and those for living environment to designated establishments of an average discharge of 50m3 or more.

Concerning the quality of effluents from the wastewater treatment plant to public

water bodies, the Sewerage Law governs pH, BOD, SS and number of Coliform groups, and the Water Pollution Control Law governs other items. Legal examination is implemented periodically by the rule of Law .

2.4 Monitoring test

The monitoring test is provided to check the following items:

- Damages in the sewerage facilities by sewerage influent
- Decline of sewage treatment functions by sewerage influent
- Impact on he environment to which goes the effluent from the wastewater treatment plant

This test monitors wastewater and sludge treatment plants to keep their good function, and possible flow-in of sewages that are likely to exert adverse impact on the maintenance of facilities.

2.5 Other examinations

This category is to check the sludge for their dissolving and containing.

These tests are necessary for disposal of waste and recycle of waste construction materials. For fertilization of sludge (return to farm ground), there is a sludge test to check the conditions.

3. Sampling of specimens and their conservation

Specimens shall be taken to required quantities, because the quantity may change according to measurement item and measurement method. When it is necessary to pre-treat specimens for storing, sampling shall be made per kind of specimen, measurement item and per measurement method.

Water quality examination is provided to appropriately maintain treatment facilities. Therefore, sampling of specimens is very important. Generally, the influent fluctuates both quantitatively and qualitatively during each of the seasons and the day, exerting influence on the quality of waters to treat. Because of this, sampling of specimens should be reviewed, including sampling places and sampling hours. Generally, the error when a sample is not taken appropriately or taken incorrectly trends to become much larger than that resulting from the examination methods used. Samples shall be taken with minute attention to produce representative samples.

Samples used for water quality examination are divided into the following categories;

(3.1) Spot Sample

(3.2) Composite sample (Grab sample)

3.1 Spot Sample

The spot sample means a specimen taken at a pre-determined time. The spot sample may be less representative with the spot and time where the specimen is taken. When using a spot sample, sampling spots and times should be determined beforehand, with another 24 hours sampling, to well understand the relationship with a daily average water quality.

The quality of wastewater is likely to fluctuate with time and place, so it is recommended to use composite samples.

3.2 Composite samples (Grab samples)

The composite sample is produced in the following manner ; specimens are taken at regular time intervals, and then mixed to form a single sample. Normally, a unit time duration is 24 hours to make samples. In other cases, samples are taken at different spots in the reaction tank and mixed to make samples ; these mixed samples are said “positional." The samples taken are same in volume. When the flow rate at each sampling place changes largely with time, sampling volume should be taken into consideration for each place. If spot samples at regular time intervals are used to make a composite sample, each sample should be determined proportionally to the flow rate at the hour concerned. Normally, the sample is taken and put in a relatively large bottle and then sufficiently mixed. After that, the required amount is taken in a pre-determined bottle.

The sampling bottle shall be protected from external pollution and allow the target component not to leak out. Especially, it should be cleaned carefully. Use of an erroneous sample method does not enable to achieve the goals of water quantity examination, and may lead to erroneous judgment. Specimens shall be taken as uniformly as possible. As a rule, examination should be implemented as immediately as possible after sample taking. If this is not possible, the sample shall be pre-treated and stored according to the measurement applied. Samples are pre-treated to concentrate the target components of a sample for the purpose of eliminating interference and interaction of components during measurement. Since the pretreatment, as in the case of sampling method, is a major factor that may influence the results of measurement, it should be done with sufficient attention. Table 1 shows a sampling method.

Table 1 Method of sample storage

Items	Container	Method of storage
pH	P,G	To be measured immediately after sampling
BOD,COD,TOC,SS	P,G	In a dark place at 0 - 10℃
Hexane extract	G	Adjust to pH4 or less with HCl(1+1)
Number of coliform groups	G	In a dark place at 0 - 5℃
Phosphorus	P,G	Chloroform(5ml/l of sample) is added, in a dark place at 0 – 10 ℃, or adjust to about pH2 with H_2SO_4(or HNO_3)(for short period storage: in a dark place at 0 -10 ℃)
Nitrogen, NH_4^+	P,G	Adjust to pH2 to 3 with HCl or H_2SO_4, in a dark place at 0 - 10 ℃(for short period storage: in a dark place at 0 -10 ℃)
NO_2^-,NO_3^-	P,G	Chloroform(5ml/l of sample) is added, in a dark place at 0 - 10 ℃(for short period storage: in a dark place at 0 -10 ℃)

4. Details of the water quality test items

The following are the water quality control items for discharging good treated water

Water temperature.

Water temperature influences DO and the growth of organisms in water. In the cold seasons, the growth speed of living matters becomes slow and the Water treatment performance is degraded. In contrast, in the hot seasons, organisms become active, thereby improving the water treatment performance.

Transparency

Unit of transparency is the degree or cm. With wastewater influent or treated water of the same kind, transparency is correlated, in many cases, to SS and BOD in water.

Therefore, in general, it is possible to estimate the degree of pollution by transparency.

pH

pH is expressed by the common logarithm of the reciprocal of the hydrogen ion concentration of water. pH-7 is neutral, pH less than 7 acid, and pH exceeding 7 alkali. Wastewater influent is usually stable, neutral or weakly alkali. But, when a large amount of wastewater from a manufacturing plant flows in, or when sludge accumulated in the piping corrupts, organic acid is generated, resulting in pH lower than the normal value. When nitrification progresses in the reaction tank, consuming alkali, pH may be lowered to about 6.0.

COD(Chemica1 Oxygen Demand)

Measure of the oxygen amount is expressed in mg/1. It is necessary for oxidizing the substances in water by an oxidizing agent. COD, like BOD, represents the amount of organic pollutants. In many cases, there is a certain relationship between COD and

BOD. As a general rule, when the ratio BOD/COD is high, treatment with activated sludge is easy, whereas when the ratio is low, treatment is difficult. Since COD can be measured in a relatively short time, its analysis method is easy and inhibition of measurement by harmful substance is not significant, this measurement is widely used in wastewater treatment plants and test of wastes from manufacturing plants.

SV(Sludge Volume)

Measure for estimating the amount of activated sludge. It takes a long time to measure MLSS, but SV Can be detemined rapidly. For this reason, MLSS is estimated from SV to control the amount of activated sludge. However the correlation between SV and MLSS differs among wastewater treatment plants, and differs from time to time even in the same plant, It is necessary to determine the SV-MLSS at a regular interval.

BOD(Biochemical Oxygen Demand)

Measure of oxygen amount is expressed in mg/1, which is consumed when organic matters in water are decomposed by aerobic microorganisms under the condition that sufficient dissolved oxygen exists, at 20°C over 5 days. To maintain stable water treatment, it is necessary to supply sufficient oxygen for BOD of the water flowing into the treatment plant. It is one of the most essential test items for design and maintenance of the wastewater treatment plant.

SS(Suspended Solids)

Substance remaining on the filter, when the influent or treated water is filtered with a filter paper (with openings of 1 μm). SS means the substance suspended in water. It is used for calculating the amount of sludge generating in the treatment plant. It is one of the essential test items for maintenance.

Fixed solids and ignition loss(Volatile Solids)

Fixed solids are remaining residue following ignition and ash of volatile residue at 600°C. The reduction in amount due to ignition is called “ignition loss”. Generally, the fixed solids represent inorganic matter and the ignition loss organic matter.

DO(Dissolved Oxygen)

Oxygen molecules dissolved in water. DO is influenced by air pressure, water temperature and salt concentration. Since much oxygen is consumed in polluted water, the DO content is small. In clean water, the DO content is near its saturation at the temperature. DO is indispensable for self-purification of water and aquatic creatures.

MLSS(Mixed Liquor Suspended Solids)

Express Concentration by mg/l of SS in the reaction tank. It is a measure of the total concentration of microorganisms in the reaction tank. With too low MLSS, sufficient coagulation cannot be obtained, resulting in insufficient floc formation. In contrast, with too high MLSS, the water treatment becomes unstable, causing turbid treated water, or unsatisfactory separation between treated water and sludge at the final sedimentation tank. It is therefore necessary to maintain MLSS within a certain range. MLSS is used for calculating BOD-SS load, SRT, sludge age, and SVI, adjust the return sludge amount and excess sludge amount. MLSS is one of important control

indexes for ensuring stable treatment of wastewater influent.

SRT(Solids retention time)

SRT is number of days during which suspended solids stay in the reaction tank. It is calculated by dividing the total amount of suspended solids in the reaction tank by the amount of underflow(excessive sludge removed from the system) per day. SRT representing the duration of sludge staying in the reaction tank influences the composition ratio of microorganisms relating to water treatment. The proliferation and activity of microorganisms are lower when the water temperature is lower, and vice versa. Therefore, in winter when the water temperature is low, stable treatment can be achieved with SRT longer than in summer.

With longer SRT, the generating excess sludge amount is smaller, and MLSS is higher. However, with SRT too higher, filamentous bacteria and antinomycetes tend to proliferate, which may cause bulking, resulting in lower settle ability of sludge and generation of scum. It is therefore necessary to keep an adequate SRT judging from he treatment status.

MLDO(Mixed liquor dissolved oxygen)

Concentration of oxygen in mg/l that is dissolved in liquor mixed with activated sludge. MLDO is an index to verify the state of oxygen supply to the reaction tank. In general, operation is controlled so that MLDO may be kept in the range from 0.1 to 0.5 mg/l at the end of the aerobic tank.

SVI (Sludge Volume Index)

Index representing settle ability and thickening ability sludge, expressed by the volume in ml of one gram of sludge 30 minutes after it was settled. SVI of normal activated sludge is about 100 to 200 ml/g in the standard activated sludge method, and 200 to 300 ml/g in the OD method with a higher MLSS concentration. When bulking occurs, SVI significantly increases.

MLVSS(Mixed Liquor Volatile Suspended Solids)

MLVSS is measured for estimating the amount of microorganisms in the activated sludge. The ratio of MLVSS to MLSS largely differs among treatment plants, depending upon the sewerage collection system(Separate system, combined system), use method of primary settling tank, properties of return water from the sludge treatment system, BOD-SS load in the reaction tank, SRT, and Sludge age. In ordinary wastewater treatment plants, MLVSS is 70 to 90%.

RSSS (Return Sludge Suspended Solids)

RSSS, that is SS in the return sludge, is measured to determine the excess sludge amount (underflow amount).The ratio between RSVSS and RSSS coincides with the ratio between MLVSS and MLSS.

Coliform group

Gram-negative asporogenous bacteria of short-rod form that breaks lactose apart in a certain span of time to produce acid and gas of a certain amount or more. Since the

coliform group rapidly decreases as Purification goes on like other ordinary bacteria, it is an index for evaluating the treatment efficiency of the treatment plant and sanitary safety of treated water.

5. Point of water quality control by each treatment process

5.1 Activated sludge process

5.1.1 Comprehension of influent volume pattern

The activated sludge process(standard process) is capable of highly efficient treatment of a relatively high pollutant load. It is, however, subject to fluctuations in influent volume and waste water quality, and must be quickly adjusted to influent volume pattern. The exact influent volume pattern must be known.

5.1.2 Control of primary sedimentation tank

The primary sedimentation tank assists subsequent process in demonstrating their respective functions. Sludge must be properly eliminated to prevent accumulation, and a uniform volume of wastewater be allocated to each tank.

5.1.2.1 Settling time

If the setting time of the primary sedimentation tank is short, a drop in SS removal efficiency may result.
If, on the contrary, settling time is long, the SS removal efficiency may rise but the BOD/SS ratio of the influent into the aeration tank would rise, resulting in occasional bulking of filamentous bacteria or the rise of activated sludge SVI and deterioration of final effluent quality.
Settling time has to be adjusted in accordance with quality, settle ability solid ratio, and SS concentration of final effluent quality.
The settling time of the primary sedimentation tank is generally l.5 hours for separate sewer systems and 3.0 hours for combined sewer systems. (Settling time is determined with respect to wet weather for combined sewer systems. So the tanks to be used may have to be restricted when the SS removal efficiency has risen too high.)

5.1.2.2 Sludge withdraw

Sludge withdraw is an important operational element which must be withdrawn in timely. Particularly care for sludge decay must be taken during hot weather.

Sludge accumulated at the bottom of tanks is normally withdrawn intermittently. The concentration of withdrawn sludge varies in accordance with the number of sludge withdraws per day and withdrawal time - in other words, by withdrawal volume.

As a general rule, the following points must be taken into consideration for sludge withdrawal:

1. Sludge accumulation may not be uniform even if the respective

influent volume is adjusted uniformly.

2. Concentration of withdrawn sludge is higher at the beginning of withdrawal and falls steadily thereafter over time.

3. Sludge volume is lower during the nighttime then during the daytime. Sludge withdrawal is most important with respect to control of the sedimentation tank. The number of sludge withdrawals and the time per withdrawal are empirically determined for the respective tanks by taking he above factors into consideration.

5.1.2.3 Scum

Scum is produced on the surface of the water of sedimentation tank and so on, mostly in the primary sedimentation tanks. Scum contains fat and oil, fibbers, solids and the like, and is eliminated by means of scum skimming devices such as the scum skimmer which is installed on the surface of the water.

5.1.3 Control of aeration tank

The operating conditions of the aeration tank are significantly affected by the quality and substances of the first aeration tank effluent, the air to flow ratio and the excess sludge volume, and the organic matter present, as well as the solid-liquid separation factor of the final sedimentation tank (effluent quality) and so on.

Accordingly, the water quality test must be performed as deemed appropriate with respect to the water quality control of the aeration tank, taking the above points into consideration.

The following four important test items will be commented on:

5.1.3.1 MLSS

The activated sludge process serves to let microorganisms ingest organic matter, and microorganism concentration participating in the purification should be the most important operational condition. However, activated sludge contains inactive components in large quantities, and separation and concentration measurement of various microorganisms are not easy. Accordingly, MLSS (Suspended solids in a mixed liquid in the aeration tank) substitutes microorganism concentration as an important water quality control item. However, there may be cases where the concentration of microorganisms participating in the purification is different even when the MLSS is same. Since no alternative for quick microorganism concentration measurement is available, optimal MLSS must be comprehended and empirically controlled for each treatment plant.

MLSS is used to compute BOD-SS load, SRT, Sludge Age, SVI and the like and to adjust return sludge volume and excess activated sludge volume.

SRT and sludge age are extremely important factors in determining whether or not to retain wastewater purifying microorganisms and nitrifying bacteria and within the treatment system, and whether to let filamentous bacteria and actinomycetes, which obstruct treatment multiply within the tank. SRT and Sludge Age are given by the

following formulae:

SRT (day)=Tank capacity(m3)×MLSS/(A+B)

A: Excess activated sludge volume (m3)×Excess activated sludge SS(mg/l)

B: Treated wastewater volume(m3/day)×Treated wastewater SS(mg/l)

Sludge age(day)=Tank capacity(m3)×MLSS(mg/l)/Influent volume(m3/day)×Influent SS(mg/l)

5.1.3.2 SV(Sludge volume)

SV is the result of settling of wastewater mixed with activated sludge after 30 minutes, as expressed in percent. If MLSS is estimated by the simplified method, or the system is operating while MLSS hardily fluctuates, SV could be the control index of activated sludge settling efficiency. Also, the settling curve prepared by computing hourly settling efficiency would show the settling characteristics of the activated sludge.

Furthermore, SVI(Sludge volume index) is used as an index to express the settling of activated sludge. It is computed by the following formulae: the greater the SVI, the lower the consideration coefficient. Though SVI varies depending on the quality and temperature of influent wastewater, treatment conditions as well as MLSS, SVI is from 100 to 150 in normal activated sludge as used by most treatment plants.

SV I(ml/g)=SV(%)×10,000/MLSS(mg/l)

5.1.4 Control of supplied air flow

Supplied air flow is normally 3-7 times of influent wastewater volume and is determined empirically by wastewater temperature, wastewater quality aeration time, MLDO (dissolved oxygen in mixed liquor), MLSS and the like.

Because most of the supplied air flow is used to agitate the mixed wastewater the final effluent quality would deteriorate even when MLDO at tank outlet is sufficient, if the supplied air flow is reduced from he specified volume.

Also, excessive supplied air flow caused excessive aeration and anomalies in the activated sludge to reduce the final effluent quality. The supplied air flow is adjusted while MLDO at tank outlet is monitored. Adjustment is by constant DO control, supplied air flow program control and ratio control. Depending on the wastewater volume pattern and the influent wastewater quality, constant supplied air flow during 24 hours would not obstruct treatment in certain cases. The electric power charge for supplied air takes up a large percent of operation cost, and excessive supplied air should be avoided. Because oxygen demand within the tank falls along the wastewater flow, tapered aeration to reduce supplied air volume in the wastewater flow direction is economically effective.

5.1.5 Return Sludge

The volume of return sludge from final sedimentation tank is adjusted in order to maintain MLSS within the speciflc range.

The return sludge volume must be adjusted so as to keep the BOD-SS load constant by MLSS control or by ratio control. The return sludge volume may be kept constant

during 24 hours in certain cases.

There may be cases in which the requisite activated sludge volume is not warranted when the return activated sludge tank is nonexistent. There are many cases in which excess activated sludge volume is adjusted in order to keep MLSS constant.

5.1.6 Control of final sedimentation tank

Settling in the final sedimentation tank is affected not only by the operational conditions of the final sedimentation tank (retention time, surface area load and so on) and hydraulic conditions (density current, short-circuit current) but also, significantly, by the activated sludge properties (condensability, settling).

Therefore, it is necessary to control the final sedimentation tank along with the other facilities, as a whole.

The following three important items will be commented on:

5.1.6.1 Settling time

The influent into the final sedimentation tank is the liquid mixture coming out of the aeration tank, which has lower sludge specific gravity and wreaths of sludge are likely to occur therein. So, it is necessary to reduce surface area load and to guarantee a longer settling time.

Although a longer settling time is less likely to cause difficulties, the prolonged anaerobic state due to he longer retention time and the decay of settled activated sludge may generate air bubbles to cause floatation of sludge.

5.1.6.2 Sludge-liquid interface

The sludge-liquid interface of activated sludge which has settled into the final sedimentation tank may be deemed to remain within a certain range, provided that control is unfailing, although subject to fluctuations in wastewater volume.

Measurement of the sludge-liquid interface and its SS show the condition of sludge settling and consolidation.

5.1.6.3 Excess sludge

Activated sludge in the aeration tank multiplies continually thereby increasing MLSS as well as SV in order to keep the MLSS of the tank constant, multiplied activated sludge is withdrawn at final sedimentation tank separately as excess sludge and being transferred to sludge treatment facility. The withdrawal volume of the excess sludge, as required to keep MLSS constant, is said to be about l% of normal influent wastewater volume. Withdrawal volume is determined empirically by influent wastewater quality and activated sludge properties. The withdrawal volume of excess sludge is computed in order to reduce MLSS in the tank by a certain volume, and excess sludge volume is adjusted accordingly.

On the other hand, concentration of return sludge tends to be higher during the nighttime. In this case, concentration of excess sludge is higher during the daytime than during nighttime. This fact is taken into consideration when excess sludge is withdrawn intermittently.

6. Biological testing

6.1 The relationship between emerging species and quality of treated water

Activated sludge is mainly composed of bacteria, protozoa, and metazoan. In the treating process inside a reaction tank, bacteria directly take in organic substances dissolved in the sewage. In the subsequent processes, protozoa take in bacteria, and metazoan take in protozoa and bacteria, forming a food chain. The kinds of those microbes appearing in activated sludge depend upon the composition of organic substances and supplied air in the sewage as well as other factors including the water temperature. Since those conditions are closely associated with what kind of treatment has been applied to the wastewater examining the microbe flora enables water quality measurement of the treated water. Biological indexes are as significant as physical ones as yardsticks against which the level of water quality can be measured.

Bacteria and Protozoa found in activated sludge are translucent as they lack pigments. Thus, the contrast is not sharp enough to allow clear observation with standard photomicroscopes. That is why phase contract microscopes or differential interference microscopes are used in testing microbes in activated sludge. Past experiences help make quick judgment since the range of emerging species is determined based on the operating conditions of the respective water treatment works and seasonal factors. Observation with microscopes is also effective in determining the concentration level of actinomycetes and filamentous bacteria that would impede solid— liquid separation in activated sludge.

6.2 Microbes that emerge in the sewage-treating process

Actually, microbes are checked by observing the types and numbers of protozoa and metazoan that are found in the activated sludge. Bacteria are smaller in size compared to protozoa or metazoan and difficult to observe with a photomicroscope.

Protozoa can be classified into a number of families based on their characteristics. The following three groups emerge in activated sludge. Sarcodina, Mastigophora, and Ciliata.

The Sarcodina: Also called Amoebida, they live on bacteria, particulate organic matters, or in some cases smaller protozoa in the water. Some of they are crusted, and others are not.

The MastigoPhora: They have one to several whip-like hairs, and many of them live on organic matters dissolved in the water. They often emerge when the state of the activated sludge is under par.

The Ciliata: The surface of a ciliate is entirely or partially covered with short hair-like structures called cilia and cirri developed from cilia, and it has an organ called haustellum.

They emerge when the purification state of activated sludge has stabilized and the treated water attains an advantageous condition. About 200 species of this family emerge in activated sludge.

Metazoa: Metazoa refers to animals that have many differentiated cells in one discrete body as contrastive to protozoa that are single-celled. Those that emerge in activated sludge include creatures belonging to the Rotifera (Rotatoria) Gastrotricha, and Nematoda.

6.3 Indexical creatures emerging under the respective water treatment conditions

Biota under each condition in the aeration tank

The following shows five major classifications of treatment conditions in an aeration tank along with associated biota and flocculation observed.

1. Flocculation and biota under a highly adverse condition (that is, when highly loaded)
2. Flocculation and biota when load is still high
3. Flocculation and biota as the treated water condition starts turning better
4. Flocculation and biota under a good treatment condition
5. Flocculation and biota when load is low (after log hours of sludge treatment)

6.3.1 Flocculation and biota under a highly adverse condition (that is, when highly loaded)

The treated water is clouded with quantity of small suspended solids(SS)。 The higher the cloudiness is, the higher the residual ratio of organic matters is in the water being treated, providing an index of the level of untreated condition. Measurement of the sludge volume (SV) would indicate unified cloudiness across the sludge. One characteristic of his state is that here is no clear boundary faces in the sludge. The sludge volume index (SVI) reaches as high as 200 or higher. Typically, the pH value in this state is higher than the inflow pH. Using a100-power microscope enables to see that flocculation is composed of very small fragments. Using a 400-power one, lμm x2-4 tubular bacteria can be observed in quantity.

6.3.2 Flocculation and biota when load is still high

The treated water contains quantity of SS, giving pale brown appearance. After long retention hours, however, solid-liquid separation occurs, providing clear supernatant fluid. Filtered treated water is not clouded because organic matters stick to bacteria and remain there. Measurement of the SV would prove that the lower portion contains settling sludge, and the sludge thickness varies from a point to point in the cylinder. The SVI value often reaches 200 or higher. The pH value is higher than the inflow pH value. Aggregated bacteria form about 20□ 30 μm flocs. Increasing the magnification

factor would enable to see the solids also contains quantity of dispersed-state bacteria.

6.3.3 Flocculation and biota as the treated water condition starts turning better

The treated water is transparent and all organic matters are eliminated. However, the sludge boundary face is not clear. The SVI value typically drops to 150 or lower, and pH is around 7.0. A high level of bacteria coagulation is observed on a microscope, and flocs may include ones as large as 500μm. Each floc has a highly aggregated dark brown center surrounded by a thinner brown portion composed of dispersed-state bacteria that have not completely aggregated yet. Part of the biota observed at this stage also appears when transiting from he good treatment condition to the dissolution stage (low-load status), requiring attention to other components in the biota. When transiting from the good treatment condition to the dissolution stage, rotifers, peranemas, arcellas, large-size amoebas and other creatures that emerge under a low-load condition are observed.

6.3.4 Flocculation and biota under a good treatment condition

A condition is referred to as a good treatment condition when a high level of bacteria coagulation is observed and adequate solid-liquid separation takes place, providing transparent supernatant fluid. SV measurement would enable to observe a clear sludge boundary face, and the SVI value drops to 150 or lower. The pH value would be around 7.0 or lower. Flocs at the good treatment stage are well compacted and large in size. The diameter of a floc is as large as 200-600μm, and only a few small flocs are dispersed. Coagulation levels are unified across flocs, presenting minor differences in thickness. In order to maintain the good condition, it is needed to keep detailed operating records for the period under a good treatment condition, so that checking can be readily performed when any abnormality occurs by comparing the operation to that under a good operating conditions.

6.3.5. Flocculation and biota when load is low (after log hours of sludge treatment)

Creatures with fat whip-like hairs and a clear-cut profile can be observed (the Mastigophora, protozoa).

As load becomes lower or inflows stop, the treated water starts generating small-sized suspended flocs, making the water clarity drop. Those small flocs are generated because bacteria start starving when food has been consumed and start eating adhesive metabolic products, which causes the state of flocs to transit from the aggregated to the original dispersed state. This state is referred to as dissolution, SV measurement would enable to observe a variety of sludge types such as sand-like sludge that readily settle as well as suspended matters that would not settle easily. In any case, the sludge boundary face is usually clear and the SVI value does not exceed 150. The pH value drops to 7.0 or lower. The biota emerging at this stage include a wide variety if classifications. Since it takes a long time for large-size creatures or clustered ones to emerge or for generation change, there presence is a proof of a long retention time and low load. the easiest counter measure should be removal of the sludge. Alternatively,

measures can be taken to prevent acidification by intermittent blower operation. Or in case he agitation rate cannot be controlled, it may be effective to operate with a lower dissolved oxygen (DO) level.

＝END=

Appendix 6 Questionnaires for Trainees

Report of questionnaires before training course

1. What is your major?
   ①Mechanical x 1/14
   ②Electric x 3/14
   ③Civil x 4/14
   ④Environmental engineering x 3/14
   ⑤Transportation engineer x 1/14
   ⑤Infrastructure x 1/14
   ⑤Forest engineer x 1/14

2. How long do you work as sewerage works officer?
   1 year x 1
   3 years x2
   5 years x 2
   6 years x 3
   8 years x 1
   10 years x 1
   17 years x 1
   18 years x 2
   20 years x 1

3. What is your work?
   - Ms Hien HSDC: supervise & test water quality of Hanoi
   - Mr Phong HSDC: plan the equipment maintenance at WWTPs
   - Mr Tuyen HSDC: management of WWT System
   - Mr Quy HSDC: O&M of equipments & facilities at Kim Lien WWTP
   - Mr Hung Danang: operate PS of sewerage & drainage
   - Mr Quy Danang: Technical staff of O&M of WWTPs
   - Ms Duc Danang: In charge of water works and environment works in WWTPs
   - Mr Dung Thanh Hoa: head of Science & Technology dept., team leader of drainage & sewerage works and infrastructure maintenance.
   - Mr Canh Danang: Deputy Manager of WWTP Hoa Cuong in Danang SDC
   - Mr Kien Thanh Hoa: SD system management
   - Mr Phong Hai Phong: Design, supervise and manage of facilities of sewerage and drainage systerm
   - Mr Khoa Haiphong: Plan to design and build, renewal/improve SD system
   - Mr Tuan & Mr Long Son La: SEWERAGE & DRAINAGE Facilities implementation
4. Have you ever taken this kind of training program?
   Yes x 11 No x 3

5. Have you ever seen and/or been to Sewage Treatment Plant?

   Yes x 10 No x 4

6. Do you have any plan to build treatment plants in your city?

   Yes (go to No.7) x 14 No (go to No.8)

7. ① When will the treatment plants be serviced?

   Hai Phong: 2014 - 2015

   Danang: 11/2007

   Son La: estimated as of 2012

   Thanh Hoa: Not decided

   ② What is the treatment method?

   Hai Phong: Biological or activated sludge method

   Danang: Anaerobic method

   Son La: Not decided

   Thanh Hoa: Not decided

   ③ How much capacity of the treatment plant?

   Hai Phong: 40,000m3/day

   Danang: 70,000m3/day

   Son La: Not decided

   Thanh Hoa: Not decided

   ④ Do you have O&M stuffs already?

   Danang: already but not synchronous

   Others: not yet

8. Which training program do you anticipate?

   ①Introduction of Sewerage Works x 9/14 ②Design of Waste Water Treatment Plant x 8/14

   ③Maintenance of Equipment x 9/14 ④Water Quality x 9/14

   ⑤Sludge Treatment Process x 10/14 ⑥Sewer Management x 12/14

   ⑦On-site Training x 7/14 ⑧Others ( )

9. If there are any comments concerning this course, please write down below.

   - Give more images, video and information about lectures
   - Give your experiences and advices

Thank you for your cooperation.

July 12, 2010

QUESTIONAIRE 1

1. Do you understand our lecture today?

   ①Over 90% x **1/13** ②70% - 90% x **10/13**

   ③50% - 70% x **2/13** ④Less than 50%

2. Do you think that today's lecture is useful for your work?

   ①Very useful x **9/13** ②Helpful x **4/13**

   ③Not helpful ④Not helpful at all

3. Is the topic in today's lecture apppropriate ?

   ① Appropriate x **4/13** ②So so x **9/13** ③Not appropriate

4. Which topic is most interesting to you today? Why?

   ① Outline

   ② Sewerage x **10/13** **(Realistic, neccesity for city**)

   ③ Provision of sewerage works x **6/13** **(close to the city's situation)**

   ④ Financial affairs x **8/13**

   ⑤ PPP x **4/13**

5. Which topics should we develop?

   ① Outline

   ② Sewerage x **2/13** **(more reference)**

   ③ Provision of sewerage works x **5/13** **(good for our work)**

   ④ Financial affairs x **6/13** **(new for Danang)**

   ⑤ PPP x **4/13** **(new for Vietnam)**

6. If you have any suggestion to us about today's course, please write down below.

   Which method is the best for developing countries?

   The level of the lecture is higher than the trainees' level. It will take very long time to apply these knowledge into reality of the country.

   Need more real examples in Vietnam

July 13, 2010

QUESTIONAIRE REPORT DAY 2

1. Do you understand our lecture today?
   - ①Over 90% **5/12**
   - ②70% - 90% **4/12**
   - ③50% - 70% **3/12**
   - ④Less than 50%

2. Do you think that today's lecture is useful for your work?
   - ① Very useful **8/12**
   - ② Helpful **4/12**
   - ③ Not helpful
   - ④ Not helpful at all

3. Is the topic in today's lecture apppropriate ?
   - ① Appropriate **3/12**
   - ② So so **9/12**
   - ③ Not appropriate

4. Which topic is most interesting to you today? Why? (Suitable for our works)
   - ① Sewerage Development **6/12**
   - ② Information from planning **3/12**
   - ③ Procedure of design **9/12**
   - ④ Design of Influent flow & facility **4/12**
   - ⑤ Some equipment in water treatment facility **6/12**
   - ⑥ Opinion from O&M to Design **7/12**

5. Which topics should we develop? Why? **(Useful for our work in the future)**
   - ① Sewerage Development **3/12**
   - ② Information from planning **1/12**
   - ③ Procedure of design **4/12**
   - ④ Design of Influent flow & facility **5/12**
   - ⑤ Some equipment in water treatment facility **10/12**
   - ⑥ Opinion from O&M to Design **3/12**

6. If you have any suggestion to us about today's course, please write down below.

_____

_____

Thank you for your cooperation.

July 13, 2010

QUESTIONAIRE 2

1. Do you understand our lecture today?
   - ① Over 90% **4/10**
   - ② 70% - 90% **4/10**
   - ③ 50% - 70% **2/10**
   - ④ Less than 50%

2. Do you think that today's lecture is useful for your work?
   - ① Very useful **7/10**
   - ② Helpful **3/10**
   - ③ Not helpful
   - ④ Not helpful at all

3. Is the topic in today's lecture apppropriate ?
   - ① Appropriate **4/10**
   - ② So so **6/10**
   - ③ Not appropriate

4. Which topic is most interesting to you today? Why?
   - ① Mechanic equipments **4/10**
   - ② Electric equipments **5/10**
   - ③ Purposes **5/10**
   - ④ Effective mainternance **8/10**
   - ⑤ How to make a mainternance plan **6/10**
   - ⑥ Examples of mainternance activities **5/10**

5. Which topics should we develop?
   - ① Mechanic equipments **4/10**
   - ② Electric equipments **6/10**
   - ③ Purposes **3/10**
   - ④ Effective mainternance **3/10**
   - ⑤ How to make a mainternance plan **5/10**
   - ⑥ Examples of mainternance activities **6/10**

6. If you have any suggestion to us about today's course, please write down below.
   - **More on-site training**
   - **Give more experienced examples**
   - **Give frequent failure/problems and solution**

July 13, 2010

QUESTIONAIRE 4

1. Do you understand our lecture today?
   - ① Over 90% **6/12**
   - ② 70% - 90% **5/12**
   - ③ 50% - 70% **1/12**
   - ④ Less than 50%

2. Do you think that today's lecture is useful for your work?
   - ① Very useful **6/12**
   - ② Helpful **6/12**
   - ③ Not helpful
   - ④ Not helpful at all

3. Is the topic in today's lecture apppropriate ?
   - ① Appropriate **11/12**
   - ② So so **1/12**
   - ③ Not appropriate

4. Which topic is most interesting to you today? Why?
   - ① Water quality **10/12**
   - ② Sludge treatment **7/12**
   - ③ Sewer system **8/12**
   - ④ Piping system **7/12**
   - ⑤ Others

5. Which topics should we develop?
   - ① Water quality **7/12**
   - ② Sludge treatment **7/12**
   - ③ Sewer system **3/12**
   - ④ Piping system **3/12**
   - ⑤ Others **2/12**

6. If you have any suggestion to us about today's course, please write down below.
   - **More on-site training**
   - **Support our cities with your experiences**
   - **Main holes in Thanh hoa city have bad smell, is there any solution?**

Report of questionnaire after training course (July 15th, 2010)

1. Do you understand our lecture today?

Choice	Number of person
1. Over 90%	**6/12**
2. 70% - 90%	**5/12**
3. 50% - 70%	**1/12**
4. Less than 50%	

2. Do you think that this course is suitable for you?

Choice	Number of person
1. Over 90%	**6/12**
2. 70% - 90%	**6/12**
3. 50% - 70%	
4. Less than 50%	

3. Is the topic in today's lecture apppropriate ?

Choice	Number of person
1. Over 90%	**12/12**
2. 70% - 90%	
3. 50% - 70%	
4. Less than 50%	

4. Is the training schedule comfortable for you?

Choice	Number of person
1. Over 90%	**10/12**
2. 70% - 90%	**2/12**
3. 50% - 70%	
4. Less than 50%	

5. Which topics are most interesting?

Choice	Number of person
1. Introduction of Sewerage works	**4/12**
2. Design the Wastewater treatment plan	**5/12**
3. Mainternance of equipments	**9/12**
4. Sewer investigation	**10/12**
5. Sludge treatment process	**10/12**
6. Piping management	**6/12**
7. Training on-site	**9/12**

6. Why?
    1. Maintenance of quipments & sludge treatment: Hanoi is the 1st city that has been receiving the initial WWTPs in Vietnam. We do not have enough experiences to solve operation failures and repair equipments… You gave me a lot of useful knowledge.
    2. Maintenance of quipments & sludge treatment: help our jobs in WWTPs become more effective
    3. General knowledge is very good. In current situation of Thanh Hoa, we can not have a WWTP. We only have wastewater collection system to treat in bio lake.
    4. Piping investigation & management that was brought from developed countries.
    5. Wastewater treatment technology
    6. Design of wastewater treatment plant is the most interesting topic because I am able to take part in the ADB sewerage project of Thanh Hoa city.
    7. Piping investigation and Intergrated control system by internet of WWTPs.
    8. I found that all topic were interesting and suitable for me, all of them are important and connecting to my current sewerage job. But, in my opinion, design of WWTP is the most important process.
    9. Piping investigation and management because there are many points that could be applied into our current works.
    10. Piping and equipment investigation and maintenance. Piping management.
    11. Maintenance of equipments because it is necessary to have a detailed operation and maintenance for equipments and facilities.
    12. Maintenance of facilities and equipments and training on-site because they are very suitable for my current job.
7. Which topics should we develop?

Choice	Number of person
1. Introduction of Sewerage works	**2/12**
2. Design the Wastewater treatment plan	**3/12**
3. Maintenance of equipments	**7/12**
4. Sewer investigation	**1/12**
5. Sludge treatment process	**4/12**
6. Piping management	**5/12**
7. Training on-site	**2/12**

8. What will you use these knowledge to apply in your work in your city? Please give details.
    1. Applying equiments' maintenance will reduce spare part costs, the WWTPs will not be postpone operating, sewerage will be treated continously, the environment will be improved… Sludge treatment will help our future a lot.
    2. Apply our knowledge into WWTP's management, maintenance plans…
    3. Make a plan of drege and repairing the sewer system.
    4. We will suggest to our management board to apply this method into our WWTP.
    5. Our city has not have WWTP yet. We hope that we can use these knowledge to apply into our sewerage works in 2015 to help serving our city.

6. I may consult to the city administrators some views of sewerage treatment works in order to give a proper request for design biding of the WWTP (if possible). Besides, I will also apply what I've learnt to operate and manage the piping and sewer system, as well as make periodical mainternance plans.
7. I will make daily plan for operation and mainternance at Danang WWTP.
8. I will suggest to Danang administrators to focus on smell removal and sewerage treatment at WWTP with experiences that I learned from JICA team.
9. I can apply the knowledge into drainage and sewerage treatment works, but the thing is our technology and sewerage treatment process is different from Hanoi.
10. I will propose piping management and mainternance for Haiphong city.
11. We will adjust to a suitable mainternance plan of facilities and equipments, re-investigate all current facilities and make daily and periodical records.

9. If there are any comments concerning this course, please write down below.
   1. This should be applied in other cities in our country.
   2. It would be more intersting if there are more images, data, solutions relating to current Hanoi issues and other cities in Vietnam.
   3. JICA should give trainees a certain business allowance to manage ourselves. Accomodation and class should be nearer for easily transport.
   4. Thanks for JICA's support in this training course, which helped us to get the importance of sewerage works in our lives. In return, I will use what I 've learnt to apply into our city's sewerage works.
   5. Thanks for your support.
   6. How can we get sponsor/ODA from JICa for Danang? Conditions and procedure?
   7. We hope that there will be more frequent training courses in the future to help improving our O&M works.
   8. Is it possible for JICA to suggest Danang city a most effective sewerage treatment method?
   9. It would be better if you can clarify the level of the training course before for suitable participants.
   10. JICA should choose a nearer hotel for easily transport and money saving.

Report of questionnaires before training course (6th September)

1. What is your major?

Sewerage & drainage engineers/workers: 8

Electric engineer: 2

2. How long do you work as sewerage works officer?

Under 2 years: 1	2 years: 1	4 years: 1
5 years: 1	7 years: 1	8 years: 2
10 years: 1	15 years: 1	20 years: 1

3. What is your work?

Sewerage & drainage engineers/system manager: 4

Sewerage and drainage worker: 2

Electric engineer: 1

Vice director of Thai Nguyen drainage company: 1

Urban lighting manager: 1

4. Have you ever taken this kind of training program? If yes, which kind of program?

Never: 8

In other countries: 2 (1 took a training course in electric system management in Belgium; 1 took a training course in sludge treatment in France)

In Vietnam: 1 (took 2 training courses by German experts

5. Have you ever seen and/or been to Sewage Treatment Plant?

Never: 6

Already: 4

6. Do you have any plan to build treatment plants in your city?

On process: 4

Not yet: 6

7. ① When will the treatment plants be serviced?

2011: Hai Duong

Over 1 year later: Ha Nam

② What is the treatment method?

Sludge treatment: Ha Nam

③ How much capacity of the treatment plant?

2500 -5000m2/day: Ha Nam

④ Do you have O&M stuffs already?

Not yet

8. Which training program do you especially anticipate?

①Introduction to Sewerage Works:	**3**	②Electric Equipment & Maintenance:	**4**
③Mechanic Equipment & Maintenance:	**4**	④Water Quality:	**5**
⑤Sludge Treatment:	**5**	⑥Piping System:	**5**
⑦On-site Training:	**5**	⑧Others ( )	

9. If there are any comments concerning this course, please write down below.

Hope to receive much guidance of sewerage treatment and equipments' O&M.

September 6, 2010

QUESTIONAIRE (1st day)

1. Do you understand our lecture today?

Choice	Number of person
1. Over 90%	**2/10**
2. 70% - 90%	**5/10**
3. 50% - 70%	**2/10**
4. Less than 50%	**1/10**

2. Do you think that today's lecture is helpful for your work?

Choice	Number of person
1. Very helpful	**2/10**
2. Helpful	**3/10**
3. Maybe in the future	**4/10**
4. Not helpful	**0/10**

3. Are the topics in today's lecture appropriate?

Choice	Number of person
1. Appropriate	**2/10**
2. So so	**8/10**
3. Not appropriate	**0/10**

4. Which topic was most interesting for you today? Please write down the topic and reason specifically.

Choice	Number of person
1. Introduction of Sewerage works	**5/10**
2. Treatment methods	**1/10**
3. PPP	**5/10**

5. Which topic do you think is needed to improve? Please write down the topic and reason specifically.

Choice	Number of person
1. Introduction of Sewerage works	**1/10**
2. Sewerage O&M	**3/10**
3. Sewerage works to the current environment	**1/10**
4. Sewerage system (piping system, sewers & STPs)	**1/10**
5. Water quality	**1/10**
6. PPP	**1/10**

6. If you have any suggestion to us about today's course, please write down below.
    - Topics should be concentrated in the O&M of the sewerage treatment in WTPs as the purpose of this training course.
    - Lecture should be focused on the technical training of O&M, not about PPP.
    - Need to expand trainees quantity and exchange more experiences.
    - Need to supply more realistic images.

.

September 7, 2010

QUESTIONAIRE REPORT (2nd day)

1. Do you understand our lecture today?

Choice	Number of person
1. Over 90%	**4/10**
2. 70% - 90%	**4/10**
3. 50% - 70%	**2/10**
4. Less than 50%	**0/10**

2. Do you think that today's lecture is helpful for your work?

Choice	Number of person
1. Very helpful	**5/10**
2. Helpful	**5/10**
3. Maybe in the future	**0/10**
4. Not helpful	**0/10**

3. Are the topics in today's lecture appropriate?

Choice	Number of person
1. Appropriate	**10/10**
2. So so	**0/10**
3. Not appropriate	**0/10**

4. Which topic was most interesting for you today? Please write down the topic and reason specifically.

Choice	Number of person
1. Electric equipment	**5/10**
2. Mainternance	**6/10**
3. On site training	**3/10**

5. Which topic do you think is needed to improve? Please write down the topic and reason specifically.

Choice	Number of person
1. Electric equipment (more information)	**3/10**
2. Equipment repair and mainternance (details)	**2/10**
	0/10
	1/10
	0/10
	0/10

6. If you have any suggestion to us about today's course, please write down below.

- I am very satisfied with the lecture.
- Need to mention about working safety for labour workers.
- Need to supplement more images about failure happened and how to fix them.
- I want to be trained on-site how to operate and mainternance the electric equipments at a STP.

.

September 10, 2010

Final Questionnaires (after training course)

These questions below are very important for HSDC and JICA to improve and continue this training course. Please write down honestly and specifically. Sharp criticisms are appreciated.

1. Throughout the training course, do you understand the contents of the course?

Choice	Number of person
1. Over 90%	**5/10**
2. 70% - 90%	**4/10**
3. 50% - 70%	**1/10**
4. Less than 50%	**0/10**

2. Throughout the training course, do you think this training course is helpful for your work?

Choice	Number of person
1. Very helpful	**5/10**
2. Helpful	**4/10**
3. Maybe in the future	**1/10**
4. Not helpful	**0/10**

3. What do you think of the level of this training course?

Choice	Number of person
1. Hard	**10/10**
2. Appropriate	**0/10**
3. Easy	**0/10**

4. Which training program was most interesting for you?

Choice	Number of person
1. Introduction to Sewerage Works	**3/10**
2. Electric Equipment & Maintenance	**8/10**
3. Mechanic Equipment & Maintenance	**7/10**
4. Water Quality	**7/10**
5. Sludge Treatment	**6/10**
6. Piping system	**5/10**
7. On-site training	**6/10**
8. Others	**0/10**

Reasons:

- Because it is very suitable to our current cities' situation.
- It helps our staffs operate and maintenance easily and more properly.
- Water quality control topic is very helpful for us to evaluate the effectivemess of STPs and if its operation is kept up with the initial design.
- I am interested in electric and mechanic equipments' topics as it is very important.
- The lecture is very appropriate for our current jobs and we hope that we can apply these knowledge into our STPs in the future.

5. Which training program should we need to improve?

Choice	Number of person
1. Introduction to Sewerage Works	**2/10**
2. Electric Equipment & Maintenance	**3/10**
3. Mechanic Equipment & Maintenance	**4/10**
4. Water Quality	**3/10**
5. Sludge Treatment	**6/10**
6. Piping system	**3/10**
7. On-site training	**4/10**
8. Others (Investment, Finance, Build)	**1/10**

Reason:

- Discussion about the current situation of our cities and suggest how to build a STP in each city.
- I would like to get more knowledge about how to repair and maintain electric and mechanic facilities and equipments in a STP.
- We want to be trained on-site for 1-2 months to be good at operation and maintenance a STP.
- We need more actual training (not theory) and study more experiences from other countries (Japan).

6. How will you make use of the knowledge you acquired in this course in your city? Please write down below specifically.
   - Our city has been building a STP. This course will help us a lot in operating and maintaining it in the future.
   - I will consult to our management board to improve our STP plan with my knowladge.
   - I will apply these knowledge into my current jobs.

7. If we hold another training course, which level of the course do you want to take?

Choice	Number of person
1. Advanced level	**7/10**
2. Basic level	**2/10**
3. Same level	**1/10**

8. Except the topics in this training course, which kinds of topics do you want to take?
   - Finance issues for building a STP in a province.

9. If you have any suggestion to us about this training course, please write down below.
   - I want to be trained on site for 1 -2 months.
   - This course is very excellent, transportation and accomodation is very comfortable. Although time is limited, the course helped us so much or jobs in the future.
   - I want to be trained more deeply about the biological treatment technology in order to operate the STP more effectively to achieve high water quality discharge.
   - The lecture is not so clear that we did not have in-dept understandings about the sewerage treatment procedures.
   - I like this course very much as it helps me to improve my knowledge about sewerage treatment.

Report of questionnaires before training course (13th September)

1. **What is your major?**

   Sewerage & drainage engineers/workers: 6

   Electric engineers: 2

   Environemt (technology) engineers: 4

   Civil engineers: 2

   None: 1

2. **How long do you work as sewerage works officer?**

1 – 2 months: 3	1 – 1.5 years: 3	2 years: 1
3 years: 1	4 - 5 years: 2	9 years: 1
10 years: 1	14 years: 1	15 years: 1

3. **What is your work?**

   Binh Duong: supervisor, manage and design technical issues in STP (2) and Sewerage & drainage executive (1)

   Bac Giang: administrator (1) and Central system control and operation (1)

   Vinh Phuc: technical staffs (2)

   HCMC: operate and manage STPs (1); planning (1)

   Son Tay: Drainage and sewerage works (2)

   Hue: Drainage and sewerage works (2)

   Ninh Binh: operate in pumping station (1); communication & management (1)

4. **Have you ever taken this kind of training program? If yes, which kind of program?**

   Never: 12

   Took part in an O&M training for STP in Singapore in 30 days.

   Joined a sewerage treatment training course in Shizuoka city, Jpan in Oct 2007

   Joined the design estimation training course by a human resource development organization cooperated with contractor Ebara.

5. **Have you ever seen and/or been to Sewage Treatment Plant?**

   Never: 6

   Already: 9

6. **Do you have any plan to build treatment plants in your city?**

   Yes: 2

   Not yet: 1

7. ① **When will the treatment plants be serviced?**

   HCMC: Binh Hung Hoa (June 2006) and Binh Hung (June 2009)

   Hue: estimated in 2020

   Son Tay: from 2007 but has not been serviced

   Vinh Phuc: 2015

   Bac Giang: July 2010

   Binh Duong: 2014

   ② **What is the treatment method?**

   HCMC: biological technology (Binh Hung Hoa) and activated sludge (Binh Hung)

Son Tay: like Truc Bach STP

Vinh Phuc: biological technology

Bac Giang: Biological technology OCO

Binh Duong: ASBR

③ How much capacity of the treatment plant?

HCMC: 30,000 m3/day (Binh Hung Hoa) and 141,000m3/day (Binh Hung)

Son Tay: 150m3/day

Vinh Phuc: 5,000m3/day

Bac Giang: 10,000m3/day

Binh Duong: 70,600m3/day (1st period: 17,600m3/day)

④ Do you have O&M stuffs already?

HCMC, Bac Giang: already

Son Tay, Vinh Phuc, Binh Duong: not yet

8. Which training program do you especially anticipate?

①Introduction to Sewerage Works:	**9**	②Electric Equipment & Maintenance:	**9**
③Mechanic Equipment & Maintenance:	**9**	④Water Quality:	**11**
⑤Sludge Treatment:	**11**	⑥Piping System:	**12**
⑦On-site Training:	**12**		
⑧Others (Budgets for sewerage O&M, Government orientation for sewerage works)			**2**

9. If there are any comments concerning this course, please write down below.

- During discussion, I wish to hear more details about O&M difficulties and solutions.
- It would be better if hand-outs are delivered to trainees before the lectures in order to have well-preparation before discussion.
- Hope to receive JICA support for our sewerage treatment system
- Design and construct a STP for Son tay
- Improve lunch for trainees; breakfast and dinner should be included

September 14, 2010

QUESTIONAIRE REPORT (2nd day)

1. Do you understand our lecture today?

Choice	Number of person
1. Over 90%	**2/15**
2. 70% - 90%	**4/15**
3. 50% - 70%	**8/15**
4. Less than 50%	**1/15**

2. Do you think that today's lecture is helpful for your work?

Choice	Number of person
1. Very helpful	**4/15**
2. Helpful	**5/15**
3. Maybe in the future	**6/15**
4. Not helpful	**0/15**

3. Are the topics in today's lecture appropriate?

Choice	Number of person
1. Appropriate	**9/15**
2. So so	**6/15**
3. Not appropriate	**0/15**

4. Which topic was most interesting for you today? Please write down the topic and reason specifically.

Choice	Number of person
1. Sludge treatment	**2/15**
2. Dehydrator	**2/15**
3. Pump maintenance	**1/15**
4. Electric equipment O&M	**5/10**
5. PPP	**2/10**
6. On site training	**2/10**

5. Which topic do you think is needed to improve? Please write down the topic and reason specifically.

Choice	Number of person
1. Treatment methods	**2/15**
2. Operation and maintenance in a STP	**2/15**
3. PPP	**3/15**
4. Control system PLC	**1/15**
5. Financial issues	**3/15**

6. Automatic control system	**1/15**
7. Sewerage works	**2/15**
8. Biological reaction tank	**2/15**
9. On-site training	**1/15**

6. If you have any suggestion to us about today's course, please write down below.
    - Lecture should be more clear and detailed.
    - Sewer system maintenance and actual situation should be discussed.
    - Training documents needs to be improved and combined into 1 book.
    - Lecture is not cleared enough.
    - Lecture is clear and easy to understand. Trainer is whole-hearted.
    - Level of trainees to be taken part in this training course and contents of the course should be clear in the invitation letter for management boards to appoint right persons.
    - Organize more training courses.

September 15, 2010

QUESTIONAIRE REPORT (3rd day)

1. Do you understand our lecture today?

Choice	Number of person
1. Over 90%	**4/15**
2. 70% - 90%	**6/15**
3. 50% - 70%	**5/15**
4. Less than 50%	**0/15**

2. Do you think that today's lecture is helpful for your work?

Choice	Number of person
1. Very helpful	**5/15**
2. Helpful	**6/15**
3. Maybe in the future	**4/15**
4. Not helpful	**0/15**

3. Are the topics in today's lecture appropriate?

Choice	Number of person
1. Appropriate	**13/15**
2. So so	**2/15**
3. Not appropriate	**0/15**

4. Which topic was most interesting for you today? Please write down the topic and reason specifically.

Choice	Number of person
1. Equipment operation and maintenance plan	**11/15**
2. Failure and solutions	**3/15**
3. Technology charts	**2/15**
4. Financial issues in O&M	**1/15**
5.	**0/15**
6. On site training	**2/15**

5. Which topic do you think is needed to improve? Please write down the topic and reason specifically.

Choice	Number of person
1. Equipment operation and maintenance plan	**8/15**
2. Failure and solutions	**2/15**
3. Technology charts	**0/15**
4. Financial issues in O&M	**0/15**
5. Other (safety)	**1/15**

6. On site training	**2/15**

6. If you have any suggestion to us about today's course, please write down below.
    - Trainers are very helpful and whole-hearted.
    - Has sludge that is transfered to dispose at landfield caused any pollution?
    - Secure and guide about safety during on-site training for trainees.
    - Need more explanation about points in slide 4,8,10,13 that are very intersting.
    - Supply more examples and experiences in real cases.

September 16, 2010

QUESTIONAIRE REPORT (4th day)

1. Do you understand our lecture today?

Choice	Number of person
1. Over 90%	**2/15**
2. 70% - 90%	**7/15**
3. 50% - 70%	**5/15**
4. Less than 50%	**1/15**

2. Do you think that today's lecture is helpful for your work?

Choice	Number of person
1. Very helpful	**6/15**
2. Helpful	**6/15**
3. Maybe in the future	**3/15**
4. Not helpful	**0/15**

3. Are the topics in today's lecture appropriate?

Choice	Number of person
1. Appropriate	**10/15**
2. So so	**4/15**
3. Not appropriate	**0/15**

4. Which topic was most interesting for you today? Please write down the topic and reason specifically.

Choice	Number of person
1. Water quality standard by VN Law	**5/15**
2. Water quality control	**5/15**
3. Importance and purposes of water quality control	**3/15**
4. Sampling	**3/15**
5. Others	**0/15**
6. On site training	**2/15**

5. Which topic do you think is needed to improve? Please write down the topic and reason specifically.

Choice	Number of person
1. Water quality standard by VN Law	**1/15**
2. Water quality control	**4/15**
3. Importance and purposes of water quality control	**0/15**
4. Sampling	**0/15**
5. Others (expericences)	**1/15**

6. On site training	**2/15**

6. If you have any suggestion to us about today's course, please write down below.
    - Instruct how to sampling and record.
    - Clear out the operation of reaction tank and other procedures in Van Tri STP.
    - Lecture needed to begin from overview into details.
    - Helpful trainers; on-site trainer should improve their training skills.

September 17, 2010

QUESTIONAIRE REPORT (5th day)

1. Do you understand our lecture today?

Choice	Number of person
1. Over 90%	**4/15**
2. 70% - 90%	**6/15**
3. 50% - 70%	**5/15**
4. Less than 50%	**0/15**

2. Do you think that today's lecture is helpful for your work?

Choice	Number of person
1. Very helpful	**7/15**
2. Helpful	**6/15**
3. Maybe in the future	**1/15**
4. Not helpful	**1/15**

3. Are the topics in today's lecture appropriate?

Choice	Number of person
1. Appropriate	**11/15**
2. So so	**4/15**
3. Not appropriate	**0/15**

4. Which topic was most interesting for you today? Please write down the topic and reason specifically.

Choice	Number of person
1. Piping system investigation	**5/15**
2. Piping maintenance	**9/15**
3. Problems during piping maintenance	**1/15**
4. Solutions	**0/15**
5. Others	**0/15**

5. Which topic do you think is needed to improve? Please write down the topic and reason specifically.

Choice	Number of person
1. Piping system investigation	**0/15**
2. Piping maintenance	**7/15**
3. Problems during piping maintenance	**4/15**
4. Solutions	**0/15**
5. Others	**0/15**

6. If you have any suggestion to us about today's course, please write down below.
    - Trainers should give more experiences during working and solutions.
    - How to make a piping investigation plan and record?
    - When will we can replace new sewers/pipes (% broken)?
    - Mr Tuyen's lecture needs to be more interesting.
    - Beside the sewer system, we need to get more information about relay pumping stations.

September 17, 2010

Final Questionnaires (after training course)

1. Throughout the training course, do you understand the contents of the course?

Choice	Number of person
1. Over 90%	**2/15**
2. 70% - 90%	**8/15**
3. 50% - 70%	**5/15**
4. Less than 50%	**0/15**

2. Throughout the training course, do you think this training course is helpful for your work?

Choice	Number of person
1. Very helpful	**5/15**
2. Helpful	**10/15**
3. Maybe in the future	**0/15**
4. Not helpful	**0/15**

3. What do you think of the level of this training course?

Choice	Number of person
1. Hard	**1/15**
2. Appropriate	**10/15**
3. Easy	**4/15**

4. Which training program was most interesting for you?

Choice	Number of person
1. Introduction to Sewerage Works	**7/15**
2. Electric Equipment & Maintenance	**9/15**
3. Mechanic Equipment & Maintenance	**11/15**
4. Water Quality	**10/15**
5. Sludge Treatment	**10/15**
6. Piping system	**9/15**
7. On-site training	**9/15**
8. Others (O&M experiences)	**1/15**
8. Others (PPP)	**1/15**

Reasons:

- Because it is very suitable to our work.

- I can see directly a STP (on-site training).
- Because this is my concern.
- We have learnt the most interesting experiences to operate and maintain a STP.
- This course will help us to apply in our city for operation and management.

5. Which training program should we need to improve?

Choice	Number of person
1. Introduction to Sewerage Works	**4/15**
2. Electric Equipment & Maintenance	**8/15**
3. Mechanic Equipment & Maintenance	**5/15**
4. Water Quality	**7/15**
5. Sludge Treatment	**9/15**
6. Piping system	**8/15**
7. On-site training	**7/15**
8. Others (Safety for labour)	**1/15**

Reason:

- Need to clear out about biological treatment; electric and mechanic mainternance topics should be given under detailed schedules for examples; on-site training should be longer to find out more details about STPs.
- More detailed.
- All lecture are too theorical, not clear.
- Time is too short, not enough time to discuss further issues.
- Piping cleaning and odour removal.

6. How will you make use of the knowledge you acquired in this course in your city? Please write down below specifically.
   - Ninh Binh province has no STP currently but I hope to use my knowledge into our drainage & sewerage works.
   - I will transfer my knowledge from this course to my colleages.
   - Apply into my current job.
   - Suggest to the management board to operate and maintain our STP better.
   - Apply into our STP to be serviced soon.

7. If we hold another training course, which level of the course do you want to take?

Choice	Number of person
1. Advanced level	**9/15**
2. Basic level	**2/15**
3. Same level	**4/15**

8. Except the topics in this training course, which kinds of topics do you want to take?
   - Training course of drainage works
   - Automatic electric system in STP
   - STP management course
   - Leak treatment technology in landfields.
   - Design a sewerage system
   - New sludge treatment method
   - Financial management of STP
   - Safety for labour

9. If you have any suggestion to us about this training course, please write down below.
   - Next training courses should be longer and more organized.
   - Training for management and operation should be separated to easily focus.
   - Hope there are more and more training courses in the future.
   - Hand-out should be delivered to trainees before every lecture.
   - Give more experiences from Japanese side.

Appendix 7 Questionnaires for Trainers

September 10, 2010

Questionnaires for Trainers

Name: Tran Cong Tuyen

Your occupational career (Job and Period): Deputy Head of Water Environment Engineering Dept.

Education: BA of Construction University – Water environment & Water works Dept.

1. As a trainer, do you think you have done well this time?

   ①Yes, I think I have done well　　**②Mostly I have done well**

   ③Yes and no.　　④No, I don't think so.

2. What was your difficulty during the lecture?

   - No training skills
   - Sewerage knowledge is limited

3. Which point do you think you have to improve for next training course?

   - Supplement the lacking skills and knowledge

4. What do you think of trainees' level about sewerage and drainage?

   ①High　　**②So so**　　③Low

5. Do you think the level of your course is appropriate for trainees?

   ①Yes.　　**②Mostly yes**.　　③Yes and no.　　④No, I don't think so.

6. According to the discussion with the trainees, which point was most interesting for them in your lecture? Please write down below specifically.

   Discussion about the O&M of a STP

7. If you have any suggestion to us about this training course, please write down below.

   - Edit the language, way of presentation to be more suitable for Vietnamese to study.

September 10, 2010

Questionnaires for Trainers

Name: Tran Minh Hien

Your occupational career (Job and Period): Head of Water Environment Laboratory

Education: BA – Major in Water environment.

1. As a trainer, do you think you have done well this time?

   ①Yes, I think I have done well　　**②Mostly I have done well**

   ③Yes and no.　　④No, I don't think so.

2. What was your difficulty during the lecture?

   - No training skills (I can not deliver all the knowledge to the trainees although I have a lot of experiences)

3. Which point do you think you have to improve for next training course?

   - Yes, I need to improve my on-site training skills, give more actual test of water quality, reasons and solutions to trainees…

4. What do you think of trainees' level about sewerage and drainage?

   ①High　　②So so　　**③Low**

5. Do you think the level of your course is appropriate for trainees?

   ①Yes.　　②Mostly yes.　　③Yes and no.　　④No, I don't think so.

6. According to the discussion with the trainees, which point was most interesting for them in your lecture? Please write down below specifically.

   Consult to their management board how to start and control a STP.

7. If you have any suggestion to us about this training course, please write down below.

   - How to protect our achievements
   - Education of environment protection

September 10, 2010

Questionnaires for Trainers

Name: Nguyen Hong Phong

Your occupational career (Job and Period): Vice director of WTE, facilities and equipments manager

Education: BA – Major in Water environment. Electric Engineer

1. As a trainer, do you think you have done well this time?

   ①Yes, I think I have done well　　**②Mostly I have done well**

   ③Yes and no.　　④No, I don't think so.

2. What was your difficulty during the lecture?

   - Preparation of lecture is not good enough.

3. Which point do you think you have to improve for next training course?

   - Improve my f¥reference documents

4. What do you think of trainees' level about sewerage and drainage?

   ①High　　②So so　　③Low

5. Do you think the level of your course is appropriate for trainees?

   ①Yes.　　**②Mostly yes**.　　③Yes and no.　　④No, I don't think so.

6. According to the discussion with the trainees, which point was most interesting for them in your lecture? Please write down below specifically.

   - Treatment technology
   - Experiences in maintenance

7. If you have any suggestion to us about this training course, please write down below.

   - Open an official course for tranfering technological O&M for STP

September 10, 2010

Questionnaires for Trainers

Name: Dang Dinh Quy

Your occupational career (Job and Period): Sewerage treatment operation team leader in Kim Lien STP

Education: BA – Major in Water environment. BA in Technology University – Mechanic Engineer

1. As a trainer, do you think you have done well this time?

   ①Yes, I think I have done well　　②Mostly I have done well

   ③Yes and no.　　④No, I don't think so.

2. What was your difficulty during the lecture?
   - No training skills
   - I have got a lot of experiences but don't know how to combine into a lecture.

3. Which point do you think you have to improve for next training course?
   - I need to find more information and improve my lecture;
   - How to communicate with trainees effectively

4. What do you think of trainees' level about sewerage and drainage?

   ①High　　**②So so**　　③Low

5. Do you think the level of your course is appropriate for trainees?

   ①Yes.　　**②Mostly yes**.　　③Yes and no.　　④No, I don't think so.

6. According to the discussion with the trainees, which point was most interesting for them in your lecture? Please write down below specifically.

   - How to operate, maintain and repair facilities when there is failure and solution for failure.

7. If you have any suggestion to us about this training course, please write down below.
   - Is it possible to supply me facility management software?

September 17, 2010

Questionnaires for Trainers

Name: Tran Cong Tuyen

Your occupational career (Job and Period): Deputy Head of Water Environment Engineering Dept.

Education: BA of Construction University – Water environment & Water works Dept.

1. As a trainer, do you think you have done well this time?

   ①Yes, I think I have done well　　**②Mostly I have done well**

   ③Yes and no.　　④No, I don't think so.

2. What was your difficulty during the lecture?

   - No training skills to attract the trainees
   - Need further preparation for my lecture.

3. Which point do you think you have to improve for next training course?

   - The above disadvantages.

4. What do you think of trainees' level about sewerage and drainage?

   ①High　　②So so　　③Low

5. Do you think the level of your course is appropriate for trainees?

   ①Yes.　　**②Mostly yes.**　　③Yes and no.　　④No, I don't think so.

6. According to the discussion with the trainees, which point was most interesting for them in your lecture? Please write down below specifically.

   - Updated information and knowledge about their current jobs.

7. If you have any suggestion to us about this training course, please write down below.

September 17, 2010

Questionnaires for Trainers

Name: Nguyen Hong Phong

Your occupational career (Job and Period): Vice director of WTE, facilities and equipments manager

Education: BA – Major in Water environment. Electric Engineer

1. As a trainer, do you think you have done well this time?

   ①Yes, I think I have done well ②**Mostly I have done well**

   ③Yes and no. ④No, I don't think so.

2. What was your difficulty during the lecture?

   - Preparation of lecture

3. Which point do you think you have to improve for next training course?

   - Improve my lecture

4. What do you think of trainees' level about sewerage and drainage?

   ①**High** ②So so ③Low

5. Do you think the level of your course is appropriate for trainees?

   ①**Yes.** ②Mostly yes. ③Yes and no. ④No, I don't think so.

6. According to the discussion with the trainees, which point was most interesting for them in your lecture? Please write down below specifically.

   - Treatment technology
   - Experiences in failure solution

7. If you have any suggestion to us about this training course, please write down below.

   - Open more training course for tranfering treatment O&M in STP

September 17, 2010

Questionnaires for Trainers

Name: Tran Minh Hien

Your occupational career (Job and Period): Head of Water Environment Laboratory

Education: BA – Major in Water environment.

1. As a trainer, do you think you have done well this time?

   ①Yes, I think I have done well　　**②Mostly I have done well**

   ③Yes and no.　　④No, I don't think so.

2. What was your difficulty during the lecture?

   - No

3. Which point do you think you have to improve for next training course?

   - Trainees can take sampling directly in STP and check the water quality based on our standards. Then, they can try to analyze and evaluate their results.

4. What do you think of trainees' level about sewerage and drainage?

   ①High　　**②So so**　　③Low

5. Do you think the level of your course is appropriate for trainees?

   ①Yes.　　**②Mostly yes.**　　③Yes and no.　　④No, I don't think so.

6. According to the discussion with the trainees, which point was most interesting for them in your lecture? Please write down below specifically.

   - Discuss about failures that we met and find out the solutions by experience exchange.

7. If you have any suggestion to us about this training course, please write down below.

   - Need more reference books of sewerage treatment to improve my skills as well as have chance to see STPs in other cities to get more experiences for my lecture.

September 17, 2010

Questionnaires for Trainers

Name: Dang Dinh Quy

Your occupational career (Job and Period): Sewerage treatment operation team leader in Kim Lien STP

Education: BA – Major in Water environment. BA in Technology University – Mechanic Engineer

1. As a trainer, do you think you have done well this time?

   ①Yes, I think I have done well　　**②Mostly I have done well**

   ③Yes and no.　　④No, I don't think so.

2. What was your difficulty during the lecture?

   - As this is my first time to be a trainer, I am a little bit lack of communication skill with trainees.

3. Which point do you think you have to improve for next training course?

   - Supplement more detailed examples from other STPs to mu lecture.
   - From details, I should combine all my experiences into a lecture.

4. What do you think of trainees' level about sewerage and drainage?

   ①High　　②So so　　③Low

5. Do you think the level of your course is appropriate for trainees?

   ①Yes.　　**②Mostly yes.**　　③Yes and no.　　④No, I don't think so.

6. According to the discussion with the trainees, which point was most interesting for them in your lecture? Please write down below specifically.

   - Trainees are very excited about the problems happened in STPs and how to slove them.

7. If you have any suggestion to us about this training course, please write down below.

Appendix 8 Interim Report for Task 4, O&M Anticipating Public Private Partnership

SOCIALIST REPUBLIC OF VIET NAM,
PEOPLE'S COMMITTEE OF HANOI CITY (PCHNI), HANOI SEWERAGE AND DRAINAGE ONE=MEMBER STATE COMPANY LIMITED (HSDC)

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

EXPERTS FOR STRENGTHENING OF THE OPERATION AND MAINTENANCE OF SEWERAGE FACILITIES IN HANOI

Interim Report for Task 4, O&M Anticipating Public Private Partnership

Task 4-1, Operation & Maintenance of Sewerage and Drainage System in Other Countries

Task 4-2, PPP models for Sewerage and Drainage projects

May 2010

ORIENTAL CONSULTANTS CO., LTD.

HELS CORPORATION

Table of Contents

1 Findings during field work (11-22 April, 6-20 May)

1.1 Current standings of Hanoi Sewerage and Drainage Company (HSDC)

Hanoi Sewerage and Drainage Company (HSDC) is an Operation and Maintenance (O&M) company of sewerage and drainage facilities owned by the Hanoi People's Committee (HPC). HSDC is categorized as One-Member Limited Liability Company from legal standing point referring to Decree no.88/2007/ND-CP. HSDC has two subsidiary companies, Wastewater Treatment Enterprise (WTE) and Urban Drainage Enterprise (UDE). HSDC sewerage budget is managed by Department of Construction (DOC) of HPC as a contractual employer. According to preliminary research of JICA, Hanoi city collects wastewater charge with the water supply charge and waste water charge accounts for 10% of water supply charge. HSDC had jointly studied the improvement of their O&M skill with GTZ through Berlin Water International in 2004.

[Note: Institutional framework and financial status of HSDC will be studied in May 2010 by the study team.]

Summary of Acknowledgement

a. Owner of sewerage and drainage facilities operated by HSDC is Hanoi People's Committee (HPC)
b. HSDC is established by HPC as the one member limited liability company for operation and maintenance of existing sewerage and drainage facilities, based on Decree no.88/2007/ND-CP, MOC Circular no.09/2009/TT-BXD, Decree no.63/2001/ND-CP, Decree no.145/2005/ND-CP.
c. HSDC has two subsidized companies, Water Treatment Enterprise (WTE) and Urban Drainage Enterprise (UDE).
d. HSDC is the contractor of Department of Construction of HPC. The contract period of HSDC may be 5 years or 10 years referring to Decree no.88/2007/ND-CP. (The study team will be investigated further in May 2010.)
e. Sewerage charge setup is stipulate in Decree no.88/2007/ND-CP, and 10% of water supply charge is planned to be collected as sewerage charge, but it is not carried out. Instead, 10% of water supply charge is collected as environmental protection fee and funded to sewerage works currently. Water supply charge system is classified into household, commercial, and industrial divisions: while commercial and industrial divisions are fixed-amount system, household division is further classified into 2

charge rates (described in the Table below). Preliminary research of JICA evaluated that 10% of water supply charge was not enough to afford sewerage works.

Environmental protection fee: 10% of water supply charge

Sewerage charge: 10% of water supply charge, but not carry out

(Decree No. 88/2007/ND-CP）

Table1. Water charge and Sewerage charge in Hanoi as of 2010

Category		Rate
Water Supply		
a	Domestic	
	- Unmetered	VND 30,000/month
	- Metered	VND 2,800/m3 up to 16m3
		VND 5,000/m3 up to 20m3
		VND 7,500/m3 over 36m3
b	Industry	VND 4,500/m3
c	Commercial	VND 7,500/m3
d	State agency & Public institutions	VND 4,000/m3
Sewerage		
a	Environmental protection fee	10% of Water charge

Source: study team

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1.2 Points acknowledged through the Relevant Organization

1.1.1 Status of HSDC (Comments from HAPI, HSD-PMB and DOC)

Relevant organizations mentioned that HSDC will be working under a competitive business environment in the future. This comment is supposed to be based on Decreeno.88/2007/ND-CP describing that new facility shall be operated by the O&M contractor through bidding procedure.

1.1.2 Acknowledgement of PPP schemes (Comments from HAPI, DOC, HSD-PMB)

Relevant organizations mentioned that the infrastructure development will surely be implemented by applying PPP schemes. MPI is presently regularizing Public infrastructure PPP schemes. The Law on PPP drafted by MPI is mainly focusing on PPP schemes accompanying with investment such as Built-Transfer (BT) contract and Built-Own-Transfer (BOT) contract. Hence it is a political decision that PPP schemes

will be utilized for emphasizing the private investment and downsizing the Government investment. In fact, the Yen So Wastewater Treatment plant is ongoing by Gemda Berthat Company of Malaysia in Hanoi under BT contract. This treatment plant will be transfered to the HPC after one-year defect liability period and Gemda Berthat will be granted land of 324ha by HPC for their commercial area development. This case is now known as public infrastructure development without government fund. HPC will additionally announce similar projects to normalize 45 lakes located in Hanoi with estimated total investment of USD 80 million. HAPI pointed out in the meeting that PPP schemes ongoing and future are concerned only about construction stage but no concerned about post construction stage. Realization of Return on Investment as per schedule is essential for the city's finance, so HAPI draws its concern about the post construction management applying PPP schemes.

1.1.3 Technical Assistance for Operation and Maintenance from Japan (HAPI's comments)

JICA's Technical Assistance on sewerage and drainage O&M was requested by HAPI in the meeting. The study team did not reply on this request due to different objectives of this study.

1.1.4 Operation of Drainage Facility (Comments of HSDC and HSD-PMB)

HSDC and HSD-PMB asked the study team to provide technical advices on not only sewerage O&M but also drainage one because of bigger share of drainage works than sewerage one in HSDC.

2 Task 4-1 Operation and Maintenance of Sewerage and Drainage in Other Countries

2.1 Goal of Task 4 O&M Anticipating Public Private Partnership

Along with economic growth and urbanization, people's attention to the environment will be increasing. Since sewerage and drainage are core urban utilities for conservation of the urban environment, they shall cater to a variety of demands such as high urban standards or further user-friendly services. On the other hand, available monetary inputs to these services are limited, meanwhile, further expansion of the services are required for quite a while. Therefore, improvements of service operations shall be made continuously by attempting downsizing, outsourcing, etc.

Public Private Partnership (PPP) is one of the project management systems with respect to the principle of a market mechanism in selection of an operator and by applying a pay-per-performance system. As the sewerage in Hanoi will be expanded rapidly in the near future, HSDC is required to make up for their unskilled parts or incompetent parts. Thus, PPP or import of expertise from the private sector is a potential solution to catch up HSDC'S skills and workforce against expansion of HSDC's service range.

Goal 4	**Output 4 from the Study Team**
Use of private firm's expertise	● Presentation of O&M of sewerage and drainage system in other countries ● Presentation of promising PPP models for Hanoi sewerage projects ● Case study for O&M plan adopting promising PPP models after the upcoming service expansion

2.2 Privatization of Operation and Maintenance of water supply and Sewerage in Other Countries

Privatization of the water supply and sewerage sector increased significantly since 1989, when the utilities in England and Wales were privatized. However, it can be said that the global market for water supply and sewerage has not reached maturity. Besides a handful of operators in France, UK and USA have a capacity to do business in the international market, and the market is highly oligopolistic. In terms of contract value, the majority of existing privatization contracts are concentrated in Europe, Gulf countries and large cities in other regions. The Vivendi Group is dominating the global market with a majority of the total investment primarily funded by the

private sector. Although the number of projects located in small and medium cities is growing, fully competent private operators relative to the demand is so far not enough due to lack of viability.

Private sector participation can take various forms, from service contracts (the smallest involvement of the private sector) to divestment/total privatization (the largest involvement). The main forms of private sector participation are categorized as: (1) service contracts; (2) management contracts; (3) lease contracts; (4) concessions; (5) divestment/full privatization; (6) BOOT (build, own, operate and transfer); and (7) private-public partnership (joint company contracts). According to the World Bank, the most common contractual form in the water supply and sewerage sector is concession. Existing forms of contracts for privatization of water supply and sewerage are shown in Table 2, abstracting from the JBIC Review no.2 2000.

Table 2 Forms of Contracts for Privatization (source: Private Sector Participation In Water Supply And Sewerage, Naohiro Kitano, Kenichi Ariga, JBIC Review No. 2 November 2000 pp 68~80)

Form (Duration)	Outline	Characteristics
Service Contract (3-5 years)	Part of the functions of an existing water supply and sewerage utility is transferred to private sector management and control for a limited time.	Functions suitable for commissioning include the management of capital programs, leakage reduction, billing and collection and information technologies.
Management Contract (5-10 years)	A private sector utility operator or consultant is awarded the rights to operate and maintain a part or the whole of a water supply or sewerage system. (Capital investment is not included.)	Objectives are to improve (i) performance and reduce costs as preparation for a more radical PSP solution; and (ii) the performance of a utility by capacity building of managers and systems. The private sector is paid fees based upon achieved performance.
Lease Contract (5-15 years)	A publicly-owned utility is rented to a PSP utility operator, which then takes responsibility for all aspects of the water supply and sewerage system, usually with the exception of capital investments.	The contract normally specifies target performance standards to be achieved.
Concessions (25-35 years)	The responsibility (including capital investment) of a utility for water supply and sewerage is transferred to the private sector for a set period of time. Contracts are usually awarded to consortia which are lead by a utility operator.	Incentives, penalties and an independent regulator come along for the effective management of operation of the whole system. Quality and profitability of the outcome depends upon the long term satisfactory operation of the system.
Divestment / Full Privatization	A publicly-owned utility, including its assets, is transferred to the private sector in perpetuity. The new private owner then operates the system under license, and under the control of a regulatory system.	This provides for high levels of efficiency and incentive-driven improvement, together with complete freedom to plan for the future and borrow for capital investment. Many countries legally forbid divestment, and this method has been used rarely.

Build, Own, Operate and Transfer (BOOT)	A project sponsor offers to sell additional bulk water to a municipality, from new physical infrastructure which the sponsor will build, own and operate for an agreed time, before the infrastructure is transferred back to the public authorities.	Suitable for a larger municipality's infrastructure expansion project. BOOT contractors usually have no responsibility for existing assets or their operation.
Private-Public Partnership (Joint Company Contract)	These are true partnerships between, for example, a municipality and a PSP utility operator in which the parties form a joint company.	Each party holds shares in the company. Such partnerships may then perform water supply and sewerage services on the basis of one of the contract structures described above. These may be more easily accepted by an untrusting electorate, but may involve conflicts of interest because of the twin role (regulator and operator) played by the public authority.

Retaining a utility under public ownership while introducing private sector methods may be a useful way. The important reasons for taking such alternative are: (1) political risk is small; and (2) the lower cost of public sector finance, in comparison with private (commercial) finance. It should be noted, however, that both of these reasons have potential disadvantages: less political risk means that the utility and its tariff remains under the control of national or local assembly, and public financing of infrastructure can often be impossible to obtain or unpredictable from year to year. The main alternatives are: (1) commercialization; (2) corporatization; (3) capitalization; and (4) twinnings as shown in Table 3.

The present issues for PPP or Private Sector Participation (PSP) in water supply and sewerage includes not only identification and formulation of large projects, but also expanding privatization targets including small and medium sized municipalities. It is highly likely that financial assistance provided by donor agencies will lead to development of new guarantee schemes and financing packages. This will also facilitate the utility operators to meet the need of the small and medium-size municipalities. However, PPP or PSP alone cannot respond to the expanding demand. What is also needed is assistance from donors to public sector operators and improvement in their management through introducing management techniques of the private sector.

Table 3 Alternatives to Private Sector Participation (source: Private Sector Participation In Water Supply And Sewerage, Naohiro Kitano, Kenichi Ariga, JBIC Review No. 2 November 2000 pp 68~80)

Method	Outline	Characteristics
Commercialization	A process by which a publicly owned utility organization is simply made more commercial. Such a utility can be given more control over its future operations and investment step by step.	This process is frequently a precursor to a PSP arrangement, since it also increases the marketability of the utility.
Corporatization	This is a legal and organizational process to	The process of corporatization

	create a publicly-owned utility organization with a separate existence to its public owner.	often involves creation of a limited company with shares owned by public organizations such as local municipalities.
Capitalization	An intermediate step between corporatization and Private Sector Participation (PSP) arrangements, which gives a corporatized utility a financial value (i.e., a balance sheet value) and is often linked to distribution of free shares to the national, regional or municipal population.	The capitalized utility is able to borrow commercial capital in order to make infrastructure investments.
Twinning	The usual format for twinning is to partner a developed, modern utility with an underperforming utility.	These arrangements have largely been less effective due to a lack of commitment by one or both parties.

3 Task 4-2, PPP models for Sewerage and Drainage projects

3.1 PPP in sewerage works of Hanoi

3.1.1 The classification of sewerage works according to ownership and management of sewerage facilities and Current standings of Hanoi city

So far sewerage works have been a sort of typical public service that is owned and managed by the public sector. But, in the large cities, it is very difficult to construct and to operate by only public sectors.

Recently Europe and the United States, where already have sewerage systems, introduced applying private funding into construction and renewal of sewerage facilities and O&M by private sector. But the number of such as them is still fewer than water supply. The next figure describes the classification of sewerage work by type of ownership and managing sectors. Currently sewerage works in Hanoi city are “Public-owned and Public-managed”. Taking into account new constructions, expansions and O&M of sewerage system scheduled in near future, it is recommendable for Hanoi to study involvement of private sector into ownership and management of sewerage works, such as “Public-owned and Private-managed” or “Private-owned and Private-managed”.

There are various types of private sector’s creative involvement in the sewerage works.

		Management	
		Public Sector	Private Sector
Ownership	Public Sector	Public owned & Public managed Type: Outsourcing Partial contract operation Comprehensive contract operation	Public owned & Private managed Type: Contract operation, DBO, Affermage (delegated services), PFI, BOT, Concession, etc.
	Private Sector	Private owned & Public managed Type; Sale and Lease back	Private owned & Private managed Type: BOT, BOO Type : Full privatization Type: Public Private Joint Company

Table 4 Classification of sewerage works according to ownership and management of facilities

Figure 1 shows transitional model between public work and private work. In this figure, current sewerage works of Hanoi city are located in outsourcing stage. By adopting the competitive circumstance, private sector’s participation can make the sewerage works more effective in technically and financially. Current standings of the contract operation

of sewerage O&M in Hanoi city can be more effective by selection of O&M company in the competitive circumstance.

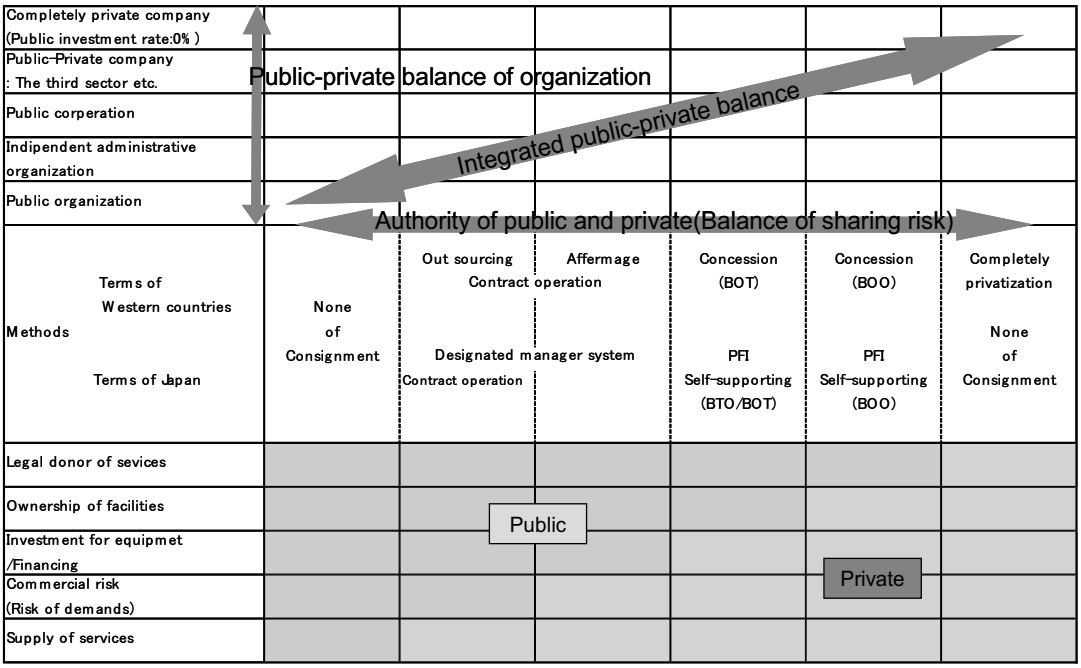


Figure 1. Types of Public-Private Partnership (PPP) and Roles of public and private sector in each type. (Ref: Development Bank of Japan Inc., 2005)

3.1.2 Proposition on development and O&M of existing facilities

A. Privatization of WTE

Hanoi city is contracting the O&M of existing sewerage facilities with HSDC. Current HSDC's performance is a workable level as a public company. However it may need to consider effectiveness of contract operation of O&M work to their subsidiary company.

Taking into account successful cases of the privatizing the public companies as the world trend, it may be desirable to privatize WTE (Water Treatment Enterprise) which is HSDC's subsidiary company in charge of O&M of HSDC's sewerage works. The objectives of WTE privatization is described below;

B. Reduction of O&M Cost

It is potential that involvement of private sector into public works may reduce the costs. For example in UK, the National Audit Office announced that privatized public works in 2000 was 15 cases that made reduction of total project costs about 20%. Reasons of reduction of the project costs are listed below;

C. Reduction of Fixed Costs

Appropriate personnel arrangement and efficient facility management can reduce O&M

costs due to reducing fixed costs such as labor cost.

D. Reduction of Flex Costs by private efforts

Private sector's originality and ingenuity in technical approach can reduce the flex costs. Latest technologies such as automatic control and energy-saving contribute to cut O&M costs. Private sector's effective operation can minimize the costs for consumables such as chemicals and electricity.

E. Selection of O&M company in competitive circumstance

If the principle of competition can work, the contract costs of O&M work can be reduced.

F. Control of O&M cost from abrupt price fluctuation

In case of the long-term O&M contract, the owner's responsible range of abrupt price fluctuation is fixed. Hence the owner can control impacts of price fluctuation to O&M charge system particularly in period of violent fluctuation in prices.

G. Improvement of service quality

By specifying the service quality of the private sector in the contract, the service quality, such as treated water quality & customer service, is guaranteed.

H. Equalization of project costs

The private sector is, in general, obligated comprehensive O&M work including the day-to-day operation and maintenance, repair work and sometime renewal work too. Hence the owner does not need to prepare such occasional costs and can equalize his expenses for the service. Appropriate repair and renewal work can prolong the lifetime of the facilities. Figure 2 describes the image of equalization of project costs.

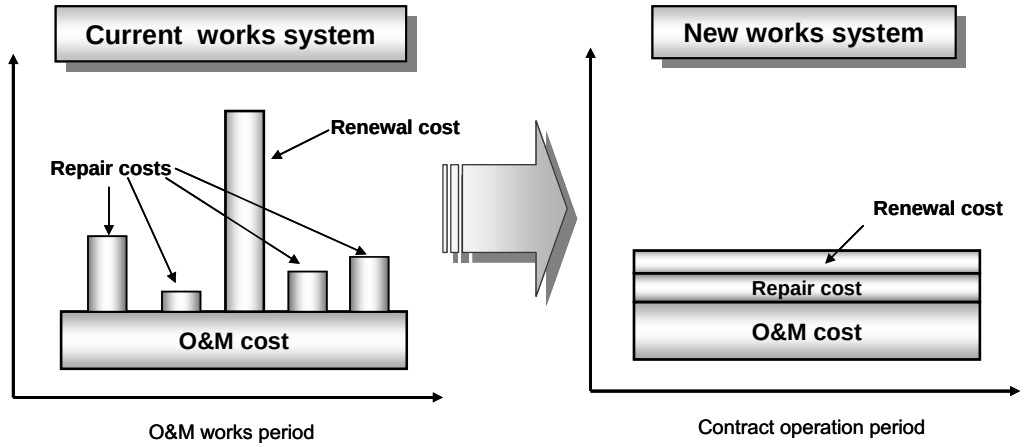


Figure 2. Image of equalization of project costs

I. Promotion of new facility investment

By equalizing the cost of repair and renewal and reducing total project cost, Hanoi city can reduce the expenditure of O&M and invest new facilities.

In order to enhance the involvement of private sector in O&M work, following points are needed to consider;

J. Existing employees of the public sector

Privatized company should take on existing public company's employees, but it is not all of them due to profitability. Cooperation between public and private is needed.

K. Fairness of contract operation fee

In order to ensure the fairness of O&M cost, third-party organizations such as consulting firms may be appropriate to estimate O&M cost.

L. Service quality

It is necessary to ensure service quality by including penalty system into contracts because private companies to be entrusted may pursue a profit and decrease service quality.

And in case of a situation that private company can't manage O&M works by expected risks, it is also necessary to set up a system which doesn't place responsibility on ordering party, such as insurance.

M. Public awareness of privatization of sewerage works

In order to avoid sense of discomfort create in public for privatization of sewerage works, it is important for public sectors to advertise activities about economic effectiveness and public supervision of the privatization of the sewerage works.

3.2 WTE privatization schemes

3.2.1 WTE privatization with capital inflow of HPC

This is a case to privatize WTE considering public good by public l and private investment. New O&M company will be constituted HPC and private company such as private O&M company, design company, construction company and consulting firm etc. (Figure 3) It is needed to evaluate O&M costs, form the O&M contract by independent third party.

Such as HSDC or DOC will be considered the organization which supervise the O&M performance of privatized WTE. However, there is room to discuss this scheme about issues of legal and efficiency.

Advantage of this case is to reflect public opinion easily because of HPC's capital contribution and to prevent following issues;

- Decrease of service quality by pursuing a profit
- Abrupt high rise of O&M cost

However, unnecessary intervention by relative public organizations into management of privatized WTE may bring about management difficulties and cause increase of the costs. Therefore, the control of intervention by relative public organizations would be important.

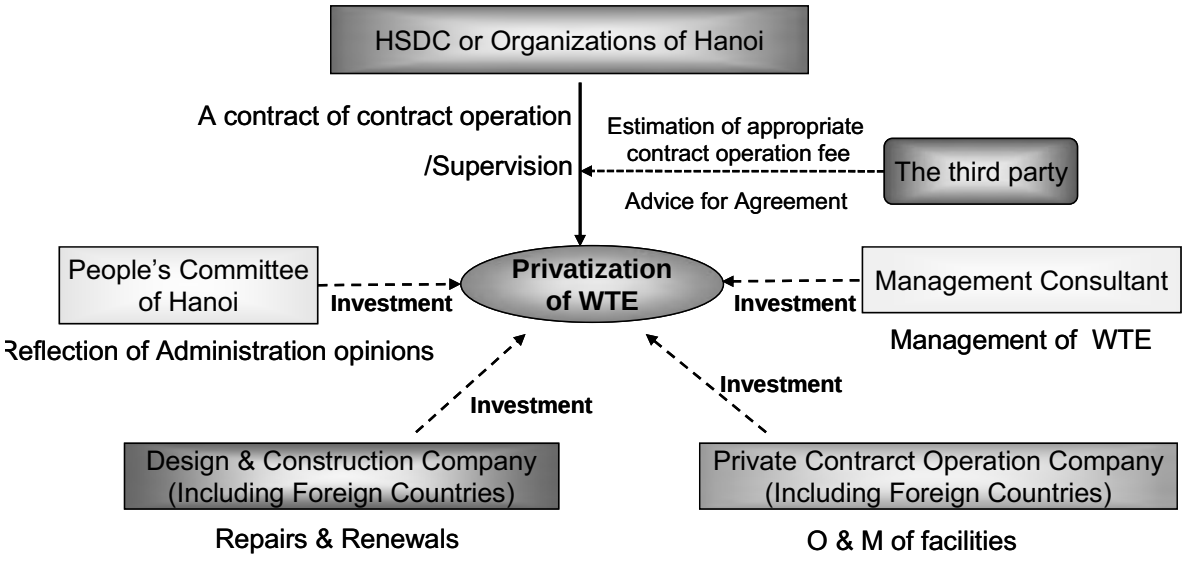


Figure 3 WTE privatization scheme 1

3.2.2 WTE privatization without capital inflow of HPC

This case is to full privatize WTE in association with such as private O&M company, design company, construction company and private consulting firm etc..(Figure 4) The privatized WTE should undertake the existing WTE. HPC doesn't contribute to management of new company. As well as the aforementioned case, it is needed to evaluate O&M costs, form the O&M contract by independent third party. However, there is room to discuss this scheme about issues of legal and efficiency.

Advantage of this scheme is for Hanoi to reduce the O&M cost through new WTE' cost saving effort in O&M work.

But, a case of a few supervision by public sector, following issues would be issued.

- Decrease of service quality by pursuing a profit
- A demand of immoderate O&M cost

Therefore, fair and proper supervision of new WTE by the regulatory board can enhance the effectiveness of new WTE's O&M work.

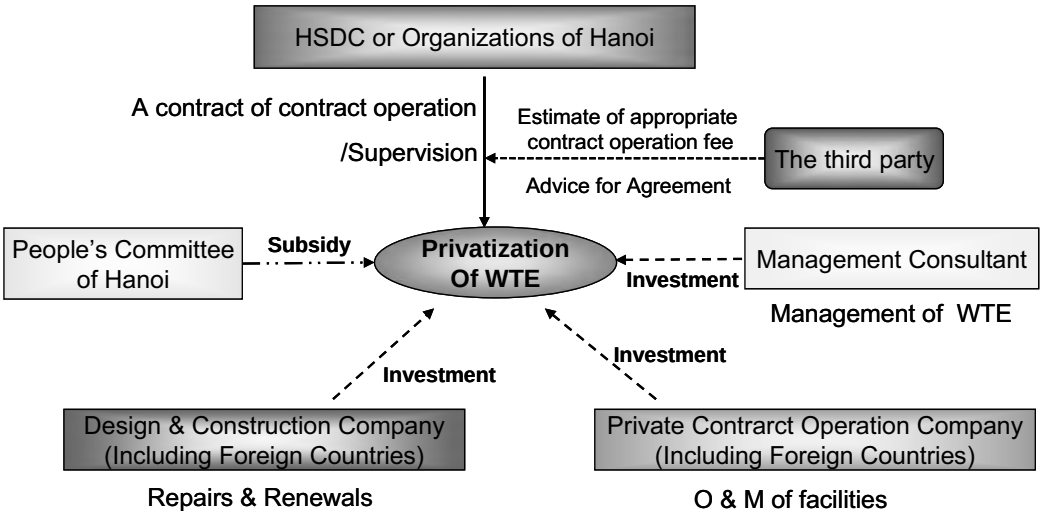


Figure 4 WTE privatization scheme 2

3.2.3 Promising case for WTE privatization

Case of privatizing WTE with scheme 1is practical because of two issues below;

A. Inactivated market of sewerage facilities contract operation in Vietnam
B. Control of O&M cost by public is needed because wastewater charge income is not enough

But, because scheme 1 has many issues mentioned in 3-2-2 A, it is necessary to fully privatize WTE of scheme 1 without HPC'c capital inflow in the future.

A. Proposition on development and O&M of scheduled facilities

A.1 Introducing Design - Build - Operate (DBO) and Design - Build - Finance - Operate (DBFO)

Number of staff and O&M costs increase according to the size of sewerage works. Small city can construct and manage the sewerage facilities by themselves easier than larger city. In fact larger city governments are used to have financial difficulties in large initial investments of sewerage developments as well as O&M costs. As a result, many of the large city governments are facing difficulties of securing funds for repayment of huge debts and costs of O&M.

In Japan's case, enormous debts are still left and that leads to decrease the amount of investment for new and renewal construction as showing in figure below;

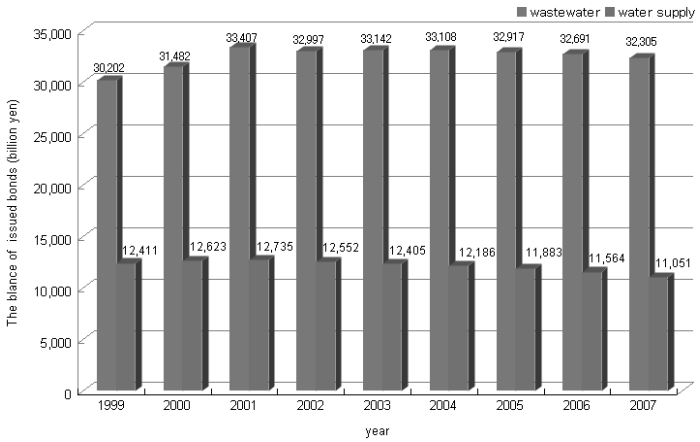


Figure 5 Situation of Japanese public enterprise debts on sewerage and water supply works

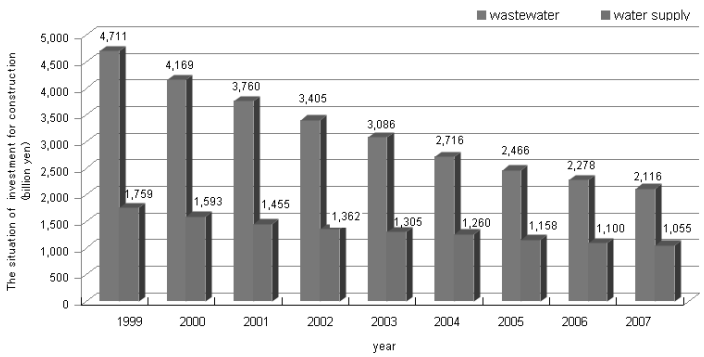


Figure 6 Changes of construction investment on sewerage and water supply works

When Hanoi city plans to expand the sewage facilities, vast amount of funds and large-scale management organization are required. For this reason, it is essential to introduce the efficient and economical facilities that are considered O&M into design and construction of new sewerage facilities. In order to reflect findings in O&M work to the design and construction of new facility, DBO method will be needed, which Design, Build, and Operation are ordered by one package, or DBFO method which adds Financing to DBO.

With DBO and DBFO methods, construction costs can decrease because private companies keen to economize their costs as small as possible in design, construction and O&M by their originality and creativeness. For instance their design must consider good function with minimum O&M costs. DBFO method can solve the shortage of public investment by infusing private funds and can promote expanding new facilities by adopting progressive payment over contract period.

Figure 7 describes the image of reducing total project cost with DBO and DBFO.

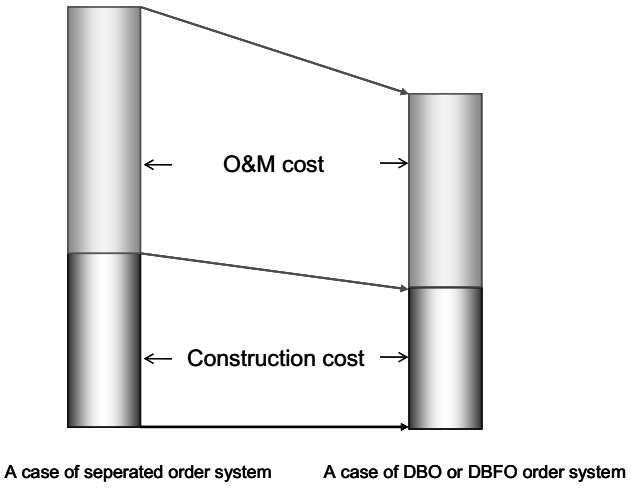


Figure 7 The image of reducing total project cost with DBO and DBFO

There are advantages of DBO and DBFO as follows;

- Reducing construction cost by inventiveness of private companies.
- Reducing O&M cost by O&M considered designing and construction.
- Avoiding over-specification in design by reflecting O&M skill for economize O&M by the DBO/DBFO contractor.
- Avoiding prolonged construction period and total project cost because the any of excess costs are risk of the contractor
- Improving service quality by using the inventiveness of private companies.
- Contributing to making profit and to promoting well-being of citizens by constructing incidental facilities and welfare facilities

- Establishing long-bond market managed by private funds, providing various investment opportunities for pension funds and insurance companies, and stimulating economy by investing surplus funds to public investment
- Providing stable investment opportunity to surplus funds

As described above, public-works implemented by private sector in 2000, including 15 cases of private introduction, decreased the project costs by about 20%, comparing projects implemented directly by the government, according to National Audit Office of U.K. introducing private-sector initiative can reduce costs in following points. In addition, the observation rates of construction cost and period with DBFO method are better than those of Ordinary financed projects (described in Figure 8).

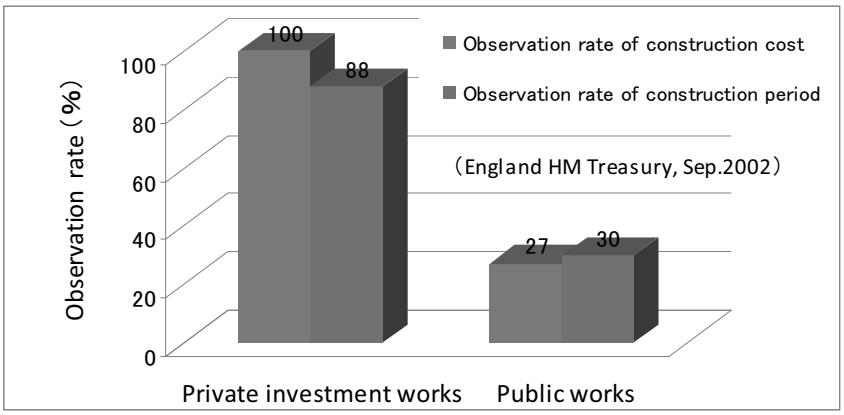
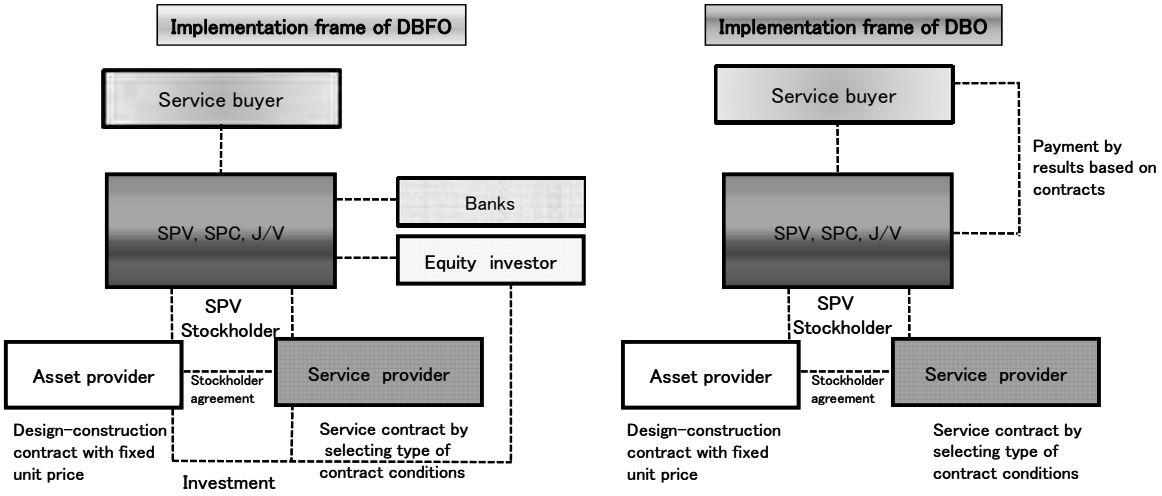


Figure 8 Comparison of the compliance rates of construction cost and period

A.2 Comparison between DBO and DBFO

Ordinary implementation structures of DBO and DBFO are described in Figure 9.



Reference：Palmer,K.,"Contract Issues and Financing in PPP/PFI-Do We Need the F' in DBFO Projects"? Prepared for the IPPR Commission on Public Private Partnerships, 2000, 13-15p.

Figure 9　Implementation structures of DBO and DBFO

DBFO method basically needs joint participation of design companies, construction companies, O&M companies, and financial investors, from the phase of project development to the phase of establishment of private-owned corporation.

However, financial investors do almost nothing about the projects from the phase of project development to the phase of stipulating contract conditions in implementation contracts. So there is an issue that other participator have to take initial and running risks that financial investors have to take, and, as a result, there occurs an issue of expensive total project costs by passing on risk avoidance costs to total project costs.

But, as for public sector, DBFO method makes it possible to resolve initial cost shortage and expand projects timely. Indeed, many profitable projects are implemented with DBFO method.

DBO method doesn't include infusion from private funds and manages the project with service charges from service buyer.

Special Purpose Vehicle (SPV) or Special Purpose Company(SPC) that are project implementing body concludes implementation contracts with service buyer and receive charges based on performance result.

DBO method is evaluated to be more flexible method to modify implementation contracts with service buyer and make negotiation smoother than DBFO method, due to the negotiation without the demand of financial investors

Comparing with DBFO, DBO method is more cost efficient than DBFO method because equity investment and loan of financial investors that intend income from capital may increase financial costs, compared with public funds.

And financial technique adopted to the projects with private funds is project finance that uses the cash flow of works for repaying a debt and requires not only additional cost but also various fees.

As project finance requires substantial time to the phase of project implementation and additional cost and various fees are fixed amount, it is desirable to adopt DBO and DBFO methods depending on the scale of project because financing costs of DBFO method based on project finance accounts for major percentage in small scale projects.

A.3 Variation of DBFO

DBFO methods are implemented in many countries with various methods. Common methods are as follows.

-BOT（Build-Operate-Transfer） Private companies build facilities with their own funds at first. After construction, they operate the facilities and collect service charge from end-users during contract period. When contract period is over, the facilities are transferred to ordering party.

-BTO（Build-Transfer-Operate） Private companies build facilities with their own funds. After construction, facilities are transferred to ordering party and private companies are granted the management right of the facilities. Then Private companies operate the facilities and collect service charge from end-users during contract period.

-BOO（Build-Owned-Operate） Private companies build and own facilities with their own funds. And they operate the facilities and collect service charge from end-users.

-BTL（Build-Transfer-Lease） Private companies build facilities with their own funds and transfer them to ordering party. Private companies are granted the management right but they lease the right to ordering party. So private companies collect lease charge.

Table 5 Comparison between BOT, BTO, BOO and BTL

BOT, BTP, BOO	Implementation Form	BTL
Facilities which could recover with the fee such as roads and harbors etc.	Feature of object facilities	Facilities which could not recover with the fee such as facilities for education and welfare etc.
Fee of users	Recovery of Investment	Rental fee of government
High risk, particularly on profitability	Risk	Low risk by securing of contractor’s profit

So far, most DBFO projects have been implemented with BOT or BTO because profitable projects have been selected, such as Electricity and Transportation.

However, facilities for education, culture, and welfare including sewerage facilities are

not profitable, therefore total project costs are returned through national and local government's lease fee, not by usage charges. This system decreases the risk of project investors, and provides stable investment opportunities

As for the fundamental differences between BTO and BTL, described Figure10, are service provider and payment recipient:
In BTO, private companies provide service to end-users and collect service charges for repayment of total project costs
On the other hand, in BTL, private companies collect lease fee from national or local government for the repayment of total project costs instead.

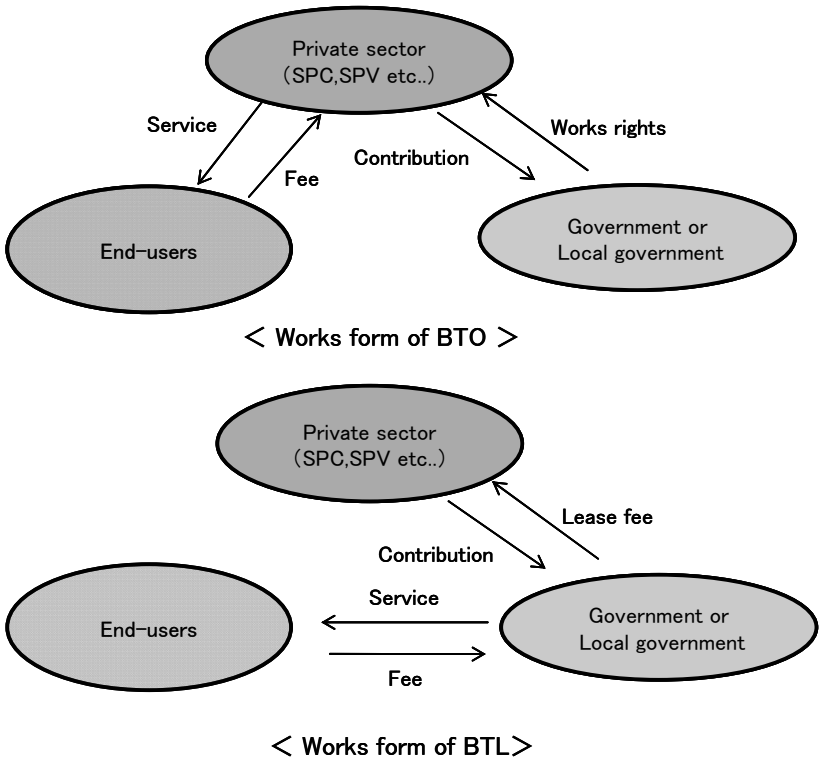


Figure 10 Implementation forms of BTO and BTL

BTL realizes following matters:

- to construct facilities in a short period while national or local government has to secure a sufficient budget over a long period.
- to reduce financial burden by sharing the expenditure over a long period.
- to receive benefits at an early date because of early implementation. Delay of the project increases total costs because of the rise of land compensation rise, price fluctuation, and etc.

Figure 11 describes the comparison of unit construction cost of subway in Seoul city,

Korea, separated by the time of construction. As the time of construction period gets longer, unit construction cost gets more expensive.

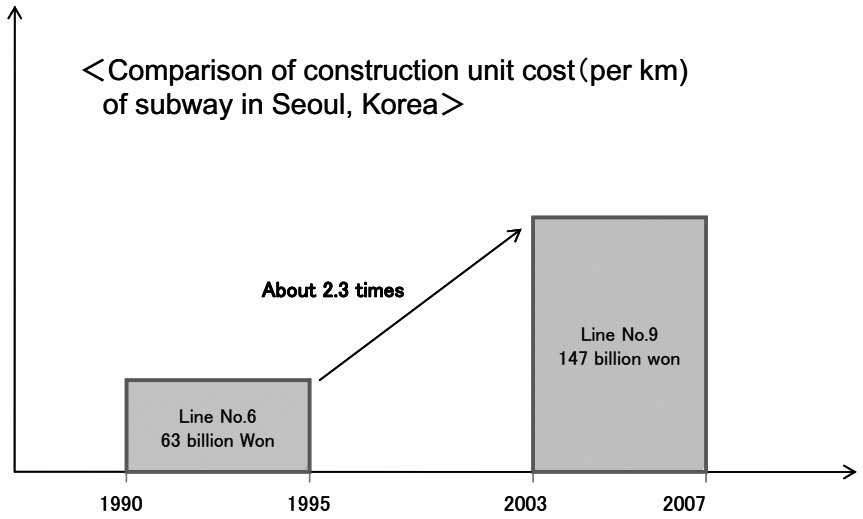


Figure 11 The comparison of unit construction cost of subway in Seoul city, Korea (separated by the time of construction)

- to shift national or local public finance to that of developed countries which utilizes not only public funds but also private funds.

In United Kingdom, Private Finance Initiative (PFI) has already been introduced and implemented in Public-works since 1992 and most PFI projects have been implemented with DBFO method. In this method, private companies implement all of the projects and government pays facility usage charges. So it is very similar to BTL method.

16 years have passed since PFI started, and there are totally about GBP 60 billion of private investment and about 600 facilities of providing their services, such as hospital, school, traffic, environment, and national defense.

In Japan, government established Act on Promotion of Private Finance Initiative (PFI-Law) in 1999 for public-sector's financial reform. According to PFI Promotion Office of Cabinet Office, 366 projects have been progressed, and of these projects, 237 projects have been providing services at the end of 2009.

3-A-1 BTL introducing method

In BTL method, private companies are to design, finance, construct and manage facilities, and they establish a Special Purpose Company (SPC) that includes financial investors, construction companies, and O&M companies etc. (described in Figure12).

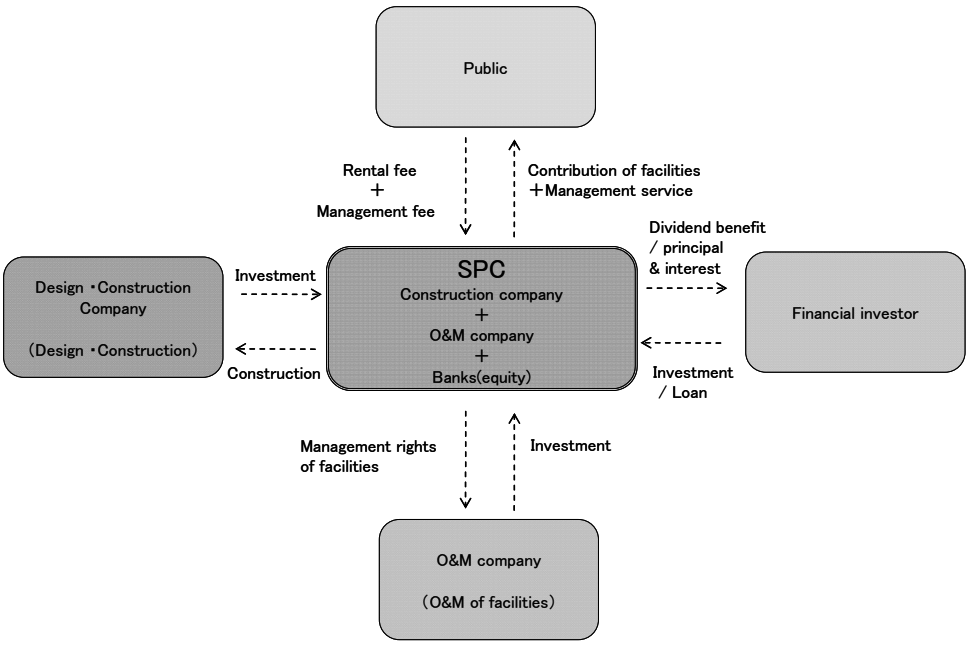


Figure 12 Structure of BTL method

The repayment of private investment includes following concerns.

- Benefit rate

  Facility-lease-charge shall be established based on a benefit rate which has a long-term investment premium (α) on interest rate of national and local debts and premium is to be set by bidding. Generally long-term receivable doesn't earn excessively because its benefit rate is higher than short-term receivable. So, premium is an appropriate rate for long-term investment and a compensation for the risk of managing with limited budget

- Management budget connected depending on result

  It is essential to include Penalty system into contract in order to keep service quality: unless the annual result doesn't come up to the contract levels, management budget is decreased. For example, in the case of schools in U.K., management budget is adjusted or decreased by evaluating contract levels of services such as air-conditioner, light, water supply, repair time etc. As for wastewater treatment plant, treated water quality, repair and renewal are evaluation criteria in order to adjust management budget.

- Profit from profitable works

  If there are incident profitable works, such as event hall, sports facility, and parking lots etc., that ease financial burden of government budget by improving usage efficiency

of facilities not to interrupt function of facilities

- Profits from them are deducted in estimating facility-lease-charge.
  So it is a good way to obligate to construct incident profitable facilities in order to ease financial burden of governments.

3-A-2

3-A-3 Items to be studied for introduction of BTL

- Scale of project
  Government should set BTL project in order to manage financial demand.
  It is necessary to invest financial works and BTL works separately through analyzing financial plans and unit costs.

- Project selection
  It is necessary to consider a scheme that can develop legal systems which prevent excessive investment, select projects rigidly, and review.
  Although BTL projects are constructed early, projects which take time for financing should be selected, and profitable projects are considered to be implemented by BTO method.

- Formulation of investment rules
  It is necessary to formulate a clear/secure investment plan and review it.

4 Subjects of Future Investigation

4.1 Public and private roles of sewerage works of Hanoi

Generally, sewerage works are broken down into the parts described Table3. Those parts can be classified into works of public or private considering legal responsibilities and efficiencies. The study team will investigate a way of PPP in Hanoi sewerage works after investigating the sewerage works of Hanoi.
For advanced sewerage works of Hanoi, it needs to introduce effective sewerage works considering public and private roles.

Table 6 Classification of sewerage works (a part of works)

Affairs of Sewarage Works (a part of works)		
Financial Affairs		Subsidy from General Account
		Sharing Charge of Relevant Municipalities
		Governmental Subsidies
		Public Enterprise Bonds
General Affairs		Regulations, Payments, Budget, Accounting, etc.
		Safe-keeping of Official Seal
		Receipt and Shipment of Documents
	Budget Implementation	Procurement Planning of Utilities (Fuels, Chemicals, Consumables)
		Design and Supervision of Utility Order
		Implementation Planning of Utility Procurement
		Capital Expenditure and Public Works Contracts
		Consignment Contracts beyond the Scope
		Revenue Expenditure or Works Contracts within the Scope
		Consignment Contracts within the Scope
	Charge Adjustment	Research of User, Adjustment of Charge (Including Approval of Usage amout)
		Collection of Charge, Research of Accrued Charge
	Beneficiary Charge	Imposition of Beneficiary Charge
		Collection of Beneficiary Charge
	Property Management	Management of Property and Equipment
	Notice of Inception in Service	Notice and Inspection of Inception in Service, Designation of Urban Sewer
Affairs of Construction and Management		Improvement Planning of Sewarage System
		Improvement Planning of Drainage System
	Relay Pumping Stations	Improvement Planning of Construction, Reconstruction, and Renewal
		Design Supervision of Construction, Reconstruction, and Renewal
		Implementation Planning of Construction, Reconstruction, and Renewal
		Implementation of Construction, Reconstruction, and Renewal
		Improvement Planning of Repair and Maintenance
		Design Supervision of Repair and Maintenance
		Implementation Planning Repair and Maintenance
		Implementation of Repair and Maintenance
	Pipe lines	Improvement Planning of Construction, Reconstruction, and Renewal
		Design Supervision of Construction, Reconstruction, and Renewal
		Implementation Planning of Construction, Reconstruction, and Renewal

4.2 Appropriate PPP schemes

In case of adopting the methods as indicated previously in O&M of existing facilities and construction and O&M of new facilities, it needs to consider the legal matters including taxation, roles of relevant organizations, and funding. On that basis, the study team will propose appropriate schemes for the sewerage works of Hanoi.

4.2.1 Privatization of WTE

- Regulator of WTE from the side of Hanoi

It is essential to supervise the service of privatized WTE. The payment for the service of WTE is adjusted with the evaluation of service. In this case, existing HSDC, DOC, or other organizations would be considered as an organization to supervise the service of WTE, and figure14 shows the schemes.Figure15 shows the case that HSDC's roles are not only supervision but also the assignee of O&M. And WTE will be the reassignee of HSDC. The study team will propose efficient methods of agreement and supervision through researching the strength and weaknesses of those schemes.

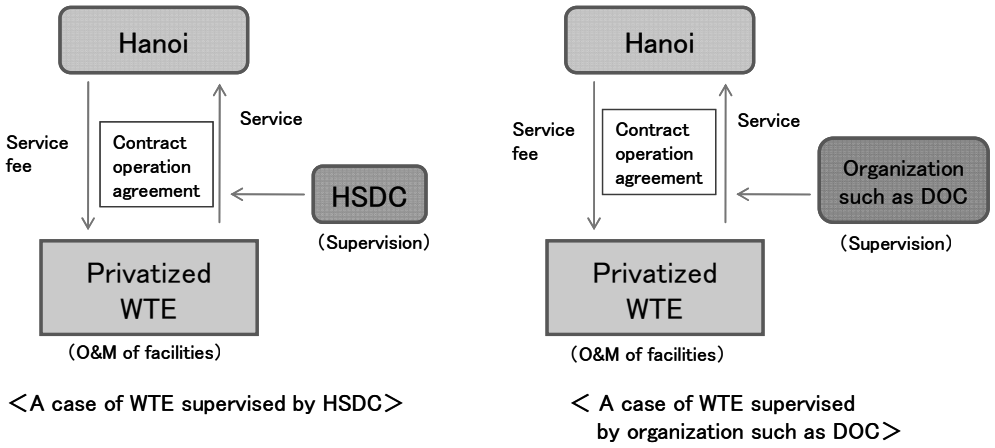


Figure 13 Supervision of privatized WTE

4.2.2 Legal Issues of privatization of WTE

It is necessary to consider the followings comparing national and local laws when Hanoi city orders contract operation to privatized WTE.

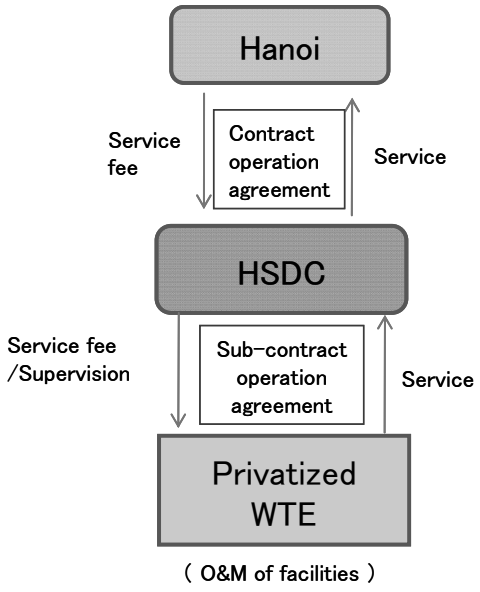
a The investment of Hanoi city and the participation of private companies etc. to establishment of SPC

b Direct appointment with privatized WTE

c Long-term contract period (10~30 years)

d Comprehensive contract operation including repair and renewal of facilities

e Penalty system with evaluation of service quality



＜A case of WTE sub-contracted and supervised by HSDC＞

Figure 14 WTE sub-contraction and supervision by HSDC

- Setting appropriate contract conditions and standard prices

The third-party organizations should be considered a party to set appropriate contract conditions and standard prices. And the study team will study and propose which organization is appropriate.

4.2.3 Project such as BTL etc. with private fund

- Legal issues on BTL method

The study team will study whether the BTL method follows Decree no.78/2007/ND-CP, which is concerned with the investment of BOT, BTO, BT, and PPP laws to be adopted from now on.

- Loan to Japanese private companies by Japanese government

The study team will also study a loan of Japanese government to Japanese private companies which participate in Japanese government assistant works to foreign countries. (Two–step Loan)

- Branch-point of project cost between DBO and DBFO

The study team will study branch-point of project cost between DBO and DBFO, with considering current circumstances of Vietnam.

4.3 Reasonable sewerage tariff in Hanoi

It is very difficult to collect the high sewerage charge because sewerage works is a kind of public works. However, collecting proper charge is important to sustain sewerage works of Hanoi.

According to Decree no.88/2007/ND-CP, wastewater tariff shall be established considering step-wise tariff increasing aiming that the wastewater tariff will cover all expenses engaged in O&M and to partly contribute to capital investment cost of sewerage works.

The study team would study and propose appropriate recovery rate considering sewerage plan and social situation etc. of Hanoi city with following references.

a. Income of wastewater charge of Hanoi
b. Expenditures of sewerage works of Hanoi (O&M, refund of debts etc.)
c. Ordinary house expenditure and Willingness-To-Pay(WTP) to sewerage charge
d. Sewerage development plan of Hanoi etc.

Appendix 9 Handout of Interim Meeting

STRENGTHENING OF O&M OF SEWERAGE FACILITIES IN HANOI

Interim Meeting on 8 July 2010

ORIENTAL CONSULTANTS Co.,LTD (OC)
HELS CORPORATION (HELS)

UNDER
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MISSION

Hanoi is advancing in wastewater management than other cities by operating 3 sewage treatment works and more number in near future. Subsequent cities such as Hai Phong and Hue are scheduling sewerage system developments and demanding to apply Hanoi's skill.

This JICA scheme is aiming to provide Japanese expertise on wastewater management in particular operation and maintenance skill of sewerage facilities.

OBJECTIVE (1/3)

Enhancement of operation & maintenance skills for sewerage services

GOAL 1

Effective operation

Prolonging equipment lifetime

OUTPUT 1 FROM TEAM

- Betterment of maintenance plan such as proactive trouble shooting & prolongation of equipment life time thru Inspection of O&M
- Enhancement of O&M skills
- Introduction of Integrated Control System

OBJECTIVE (2/3)

Technical Transfer Program to the Other Cities

GOAL 2

Technical Transfer of O&M skills owned by Hanoi to Other Cities

Accumulation of O&M skills in Vietnam

OUTPUT 2 FROM TEAM

- Advise to HSDC staff to prepare O&M Training Program and Materials for Training Course
- Assist HSDC to conduct Technical Transfer Program to Other Cities

JOINT WORK WITH HSDC is INDISPANSABLE!!

OBJECTIVE (3/3)

O&M in consideration of Public Private Partnership

GOAL 3

Seeking PPP model for O&M of Sewerage Service to be suitable for VIETNAM.

OUTPUT 3 FROM TEAM

- Study on O&M of Sewerage and Drainage System in Other Countries
- Study on promising PPP Models for Hanoi Sewerage

TASK 1

Facility Function Investigation/Diagnosis

TASK-1 *EXPECTED RESULTS*

ORIENTAL CONSULTANTS CO., LTD. Global Consulting W.Q. HELS CORPERATION

Step 1 — ***Inspection of Current O&M Situation & Established Equipment Situation***

Step 2 — *Suggestion for Betterment Plan of O & M*

Goal — *Enhancement of O & M skills*

Expected Results

1. *Guarantee of Good Treated Water Quality*
2. *Reduction of O&M Costs*

TASK-1 *SCHEDULE*

ORIENTAL CONSULTANTS CO., LTD. Global Consulting W.Q. HELS CORPERATION

Apr | May | Jun

May 6th – Jun. 3rd → ***Inspection***

Jul | Aug | Sep | Oct | Nov

Supplemental Review ← Jun. 30th – Jul.22th

Sep.1st – 30th — Final Review

CUPPENT

Oct. ~ Nov. — FINAL REPORT

TASK-1 *WORK DONE*

ORIENTAL CONSULTANTS CO., LTD. Global Consulting W.Q. HELS CORPERATION

- *FIRST FUNCTIONAL INSPECTION* of sewage treatment plants and storm water pumping station
  - Checking existing facilities condition
  - Checking current maintenance plan
  - Checking maintenance log data
- *WATER QUALITY CHECK* in sewage treatment process and of treated sewage effluent
- Study for applicability of INTEGRATED CONTROL SYSTEM

TASK-1 *PROPOSAL*

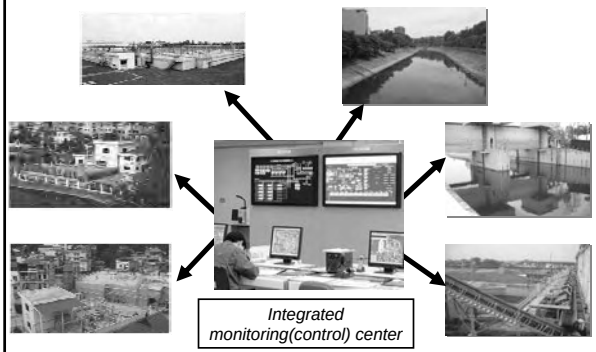
ORIENTAL CONSULTANTS CO., LTD. Global Consulting W.Q. HELS CORPERATION

1. Accumulation of O&M Data ⇦ery Essential
2. Application of accumulated O&M Data for effective operation and maintenance
3. Continuous calibration and rectification of O&M work based on O&M data for staff's skill-up and reliable operation and maintenance
4. Advice for better maintenance plan such as proactive trouble shooting & prolongation of equipment life time
5. Suggestion of integrated control system to achieve effective management for future

Hanoi city must be a leader of Vietnam sewerage service

ORIENTAL CONSULTANTS CO., LTD. Global Consulting W.Q. HELS CORPERATION

Integrated control(monitoring) System



Integrated monitoring(control) center

ORIENTAL CONSULTANTS CO., LTD. Global Consulting W.Q. HELS CORPERATION

Advantages of Integrated Control System

- Effective sewerage & Drainage management
- Effective asset and utility management
- Energy-saving management
- Preventing human errors and disaster
- Formulation of warming system

TASK-2

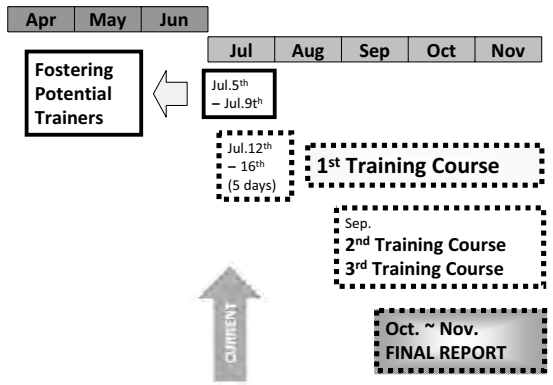
Training Course

TASK-2 *EXPECTED RESULTS*

- New sewerage development is expected in many cities of Vietnam at near future.
- The O&M skills of HSDC are needed in many cities of Vietnam.
- Settlement of Training course by HSDC
- Contribution to Development of Sewerage Works in other cities of Vietnam

HSDC could be a leader of all Vietnam in sewerage system.

TASK-2 *SCHEDULE*

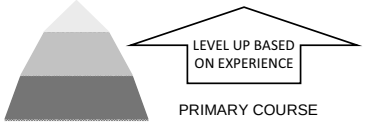


TASK-2 *WORK DONE*

- Planning the training course program, such as
  - Overall service management
  - Operation and maintenance
  - Process management, and so on
- Preparing the training materials for each parts of the program

TASK-2 *PROPOSAL*

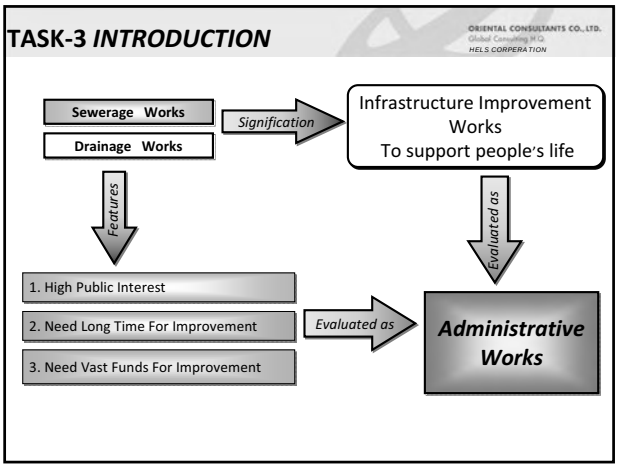
- It would be better to continue this training course as a regular course.
- Moreover, it is recommendable to promote the regular training course to an advanced course in order to build up further skills and knowledge of sewerage system.



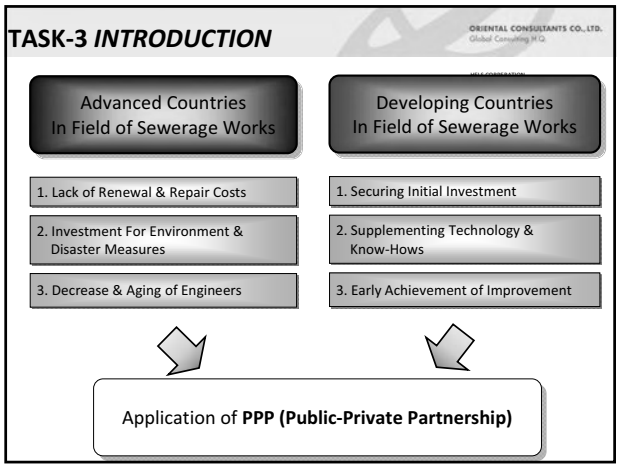
TASK-3

Public-Private Partnership (PPP)

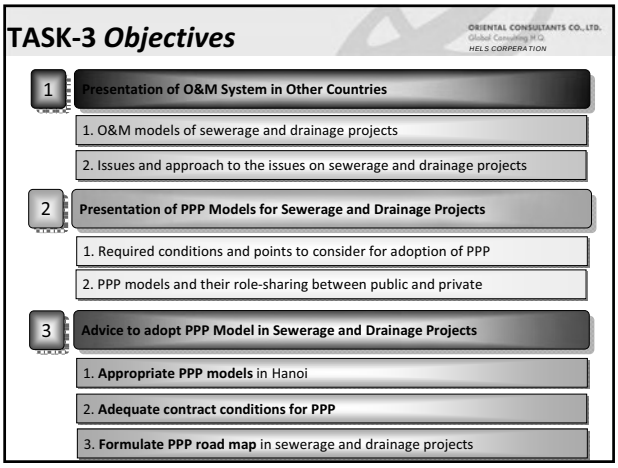
TASK-3 *INTRODUCTION*



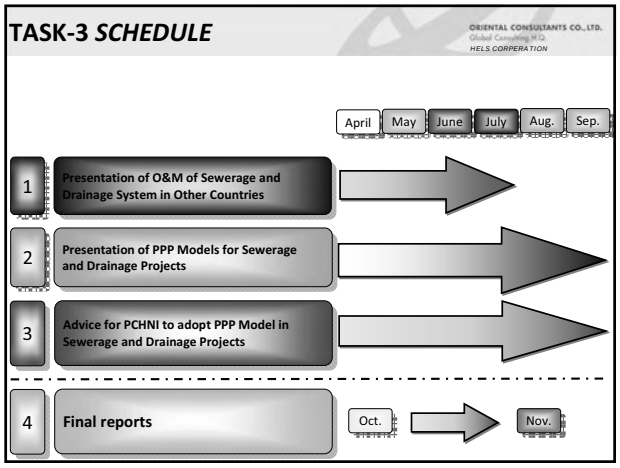
TASK-3 *INTRODUCTION*



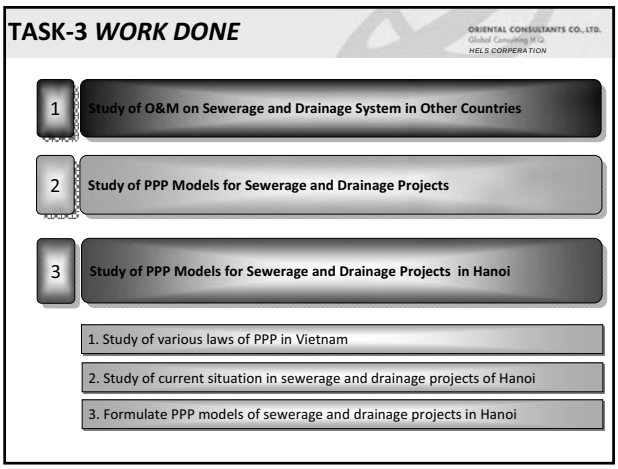
TASK-3 *Objectives*



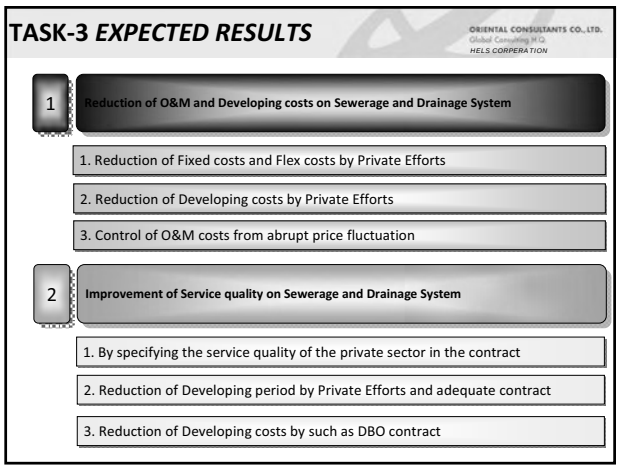
TASK-3 *SCHEDULE*



TASK-3 *WORK DONE*



TASK-3 *EXPECTED RESULTS*



Appendix 10 Handout of Wrap-up Meeting

STRENGTHENING OF O&M OF SEWERAGE FACILITIES IN HANOI

Wrap-Up Meeting on 28 Sep. 2010

ORIENTAL CONSULTANTS Co.,LTD (OC)
HELS CORPORATION (HELS)

UNDER
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Purpose of Wrap up meeting

Share the experiences, lessons learned in course of this technical assistance with counterparts, JICA and the study team.

Our presentation is composed of;

1. Review of Current Conditions and Findings
2. Target Setting
3. Strategy to attain the Target
4. Actions to be taken & Necessary Support

WRAP-UP MEETING AGENDA

Chaired by Mr. Nguyen Le, President director of HSDC

Topic	Presenter	Time
1. Opening Address	Mr. Nguyen Le	10 min
2. Presentation of JICA team		
a. General	Mr. K.Suzuki	5 min
b. Inspection of 3 STPs and Yen So PS	Mr. H.Onuki, Mr. K.Kinoshita	20 min
c. O&M Training Course	Mr. Y.Ono	15 min
d. O&M anticipating PPP	Dr. H.Y. KIM	20 min
e. Subsequent schedule and remaining subjects	Mr. K.Suzuki	10 min
3. Discussion and Comments		30 min
4. Conclusion	Mr. Nguyen Le	10 min
	Total	120 min

TASK 1

Facility Function Investigation / Diagnosis

1-1 Objective of Task 1

Inspection of Current O&M Situation & Established Equipment Situation

⇩

Suggestion for Betterment Plan of O & M

1-1 Objective of Task 1

Kim Lien STP
Capacity : 3,700m3/day

Truc Bach STP
Capacity : 2,500m3/day

North Thang Long STP
Capacity : 42,000m3/day

Yen So PS
Capacity : 45m3/sec

1-2 Review of Current Conditions & Findings

- *FUNCTIONAL INSPECTION* of sewage treatment plants and storm water pumping station
  - Checking existing facilities condition
  - Checking current maintenance plan and log data
- *WATER QUALITY CHECK* in sewage treatment process and of treated sewage effluent
- Study for applicability of *INTEGRATED CONTROL SYSTEM*



1-3 Outcome Analysis

Strong Points of O&M

Sector	**Strong point**
Operation	• Keeping discharge standard of regulation • Scheduled operation for sludge treatment
Maintenance	• Separated Maintenance team for 3 STPs • Logging data and turning over to the next shift by the diary

1-3 Outcome Analysis

Weak Points of O&M

Sector	**Weak points**
Operation	• Lack of efficient water treatment process management • No adequate operation manual for treatment process • High water content of sludge cake • Lack of risk management manual • Hard for checking water quality
Maintenance	• Lack of understanding for prolonging equipment life-time • Hard for checking equipment status
Common	• Lack of data amassment and analysis system

1-4 Targeted Goal

1 Keeping of better discharge
- Lack of efficient water treatment process management
- No adequate operation manual for treatment process
- Lack of risk management manual

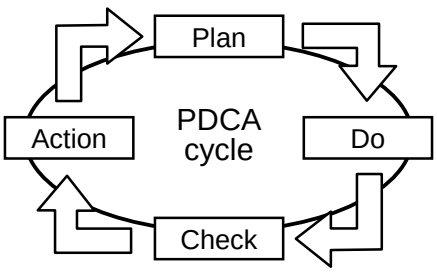
2 Reduction of O&M cost
- Lack of understanding for prolonging equipment life-time
- Lack of data amassment and analysis system
- High water content of sludge cake

3 Facility improvement for effective O&M
- Hard for checking water quality
- Hard for checking equipment status

1-5 Strategy & Action

Most important action for betterment plan of O&M

Improving PDCA cycle



1-5 Strategy & Action

Goal 1	Keeping of better discharge
Strategy 1-1	
Making and revising operation manual including risk management manual for water quality	
Action	
Understanding treatment process and system	
Improving operation manual with water quality data	
Countermeasure for pollution load fluctuation	
Improving risk management manual for water quality	

1-5 Strategy & Action

Strategy 1-2
Grasping water quality condition
Action
Adoption of portable instruments (ORP, DO, pH, MLSS)
Adoption of portable test kit for water quality

1-5 Strategy & Action

Goal 2	Reduction of O&M cost
Strategy 2-1	
Enhancement of HSDC's maintenance manual	
Action	
Making HSDC's maintenance plan	
Arranging equipment manuals	
Effective data amassment and analysis system	
PR activities for reduction of pump repairing cost	

Making HSDC's maintenance plan

Example of maintenance plan table

Name	Daily	Monthly	6 months	Yearly	Long-term
Inlet pump	Noise	Current Ins. Resistance Dis. Pressure		Lift-up checking	
Blower	Noise Smell	Current Dis. Pressure	Vibration level Ins. Resistance		Over-haul
Sludge pump	Noise Smell Gland-packing	Current Dis. Pressure	Ins. Resistance		Over-haul
Scraper	Noise Smell	Current	Ins. Resistance		Over-haul

Effective data amassment and analysis system

Image of Equipment Sheet (pump)

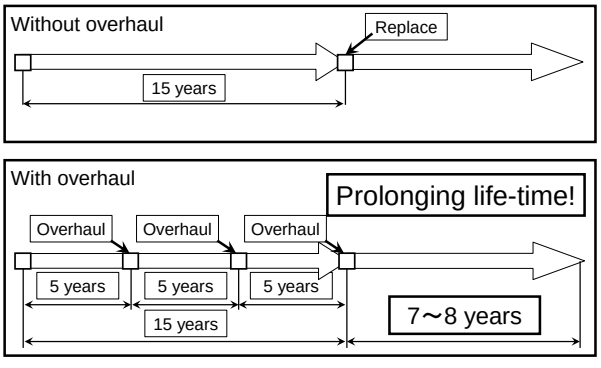
Tag No / Name	IP-1 / No.1 Inlet pump	Picture
Installed year	Sep 2003	
Installed place	Grit chamber room	
Specification	100A x 13mH x 2.5m3/min x 5.5kW x 400V	
Oil / grease No	********	
Drawing No	G9607-RGEM-01	

Measuring results (every month) in 2009

items	1	2	3	4	5	6	7	8	9	10	11	12
Current (A)	9.6	9.4	9.6	9.5	9.3	9.2	9.2	9.4	9.5	9.4	9.6	9.6
Discharge Pressure (MPa)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Ins. Resistance (M ohm)	∞	∞	∞	∞	70	30	25	18	∞	∞	∞	∞

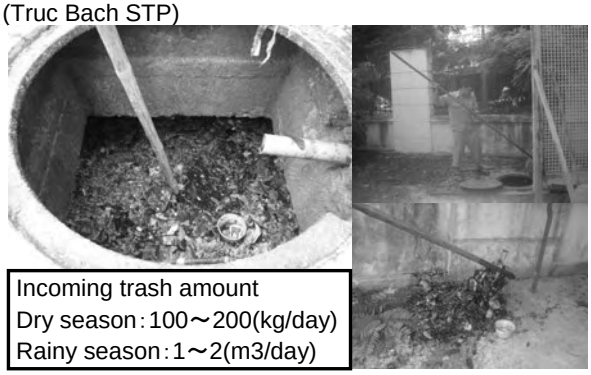
Image of long-term maintenance plan

*The case of standard equipment life-time is **15** years*



PR activities for reduction of pump repairing cost

Clearing away trash from the inlet man-hole (Truc Bach STP)



Incoming trash amount
Dry season：100～200(kg/day)
Rainy season：1～2(m3/day)

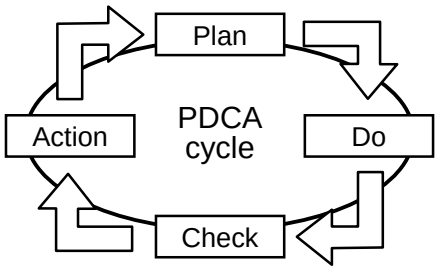
1-5 Strategy & Action

Strategy 2-2
Improving of equipment data-base
Action
Step-by-step adoption of computed equipment data-base

Strategy 2-3
Reduction of sludge disposal cost with decreasing water content
Action
Adoption of adequate polymer for sludge through test
Controlling of dehydrator operating condition through test

1-5 Strategy & Action

Most important action for betterment plan of O&M
Improving PDCA cycle

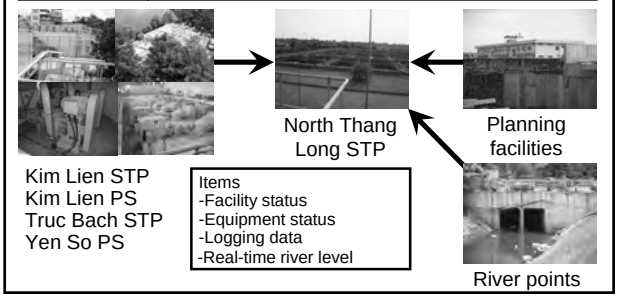


1-5 Strategy & Action

Strategy 2-4
Improvement of risk management and cost saving with Integrated Control System (ICS)
Action
Introduction of ICS

1-5 Strategy & Action

ICS	Suggestion of step-by-step introduction
Step 1	For existing facilities
Step 2	For planning facilities, all PSs and river points



Kim Lien STP
Kim Lien PS
Truc Bach STP
Yen So PS

Items
-Facility status
-Equipment status
-Logging data
-Real-time river level

1-5 Strategy & Action

ICS	Rough cost for introduction

Estimated : September 2010
Rate : 1VND = 0.0047JPY

Step 1	Approximately 25 billion VND

Step 2	Approximately 120 billion VND

Not including existing facilities repair and/or replacement cost

1-5 Strategy & Action

Goal 3	Facility improvement for effective O&M

Action
Detail inspection of hardness for checking in facilities for O&M
Improvement of hardness for checking in facilities for O&M

1-5 Strategy & Action

Example of hard for O&M

Truc Bach STP & Kim Lien STP

- Make a window in each step of STP for sampling and often condition check
- Replace tank covers for preventing labor falling and injure
- Make stage around dehydrator for maintenance

North Thang Long STP

- Change from present sludge collector to new central suspension type one for preventing frequent troubles
- Install sludge thickening equipment before sludge storage tank for stable dewatering and cost reduction
- Improve sludge cake hopper for reducing working cost and odor production and keeping clean

TASK-2

Training Course

2-1 Objective of the Training Course

New sewerage development is expected in many cities of Vietnam at near future.

↓

The O&M skills of HSDC are needed in many cities of Vietnam.

↓

Settlement of Training course by HSDC

↓

Contribution to Development of Sewerage Works in other cities of Vietnam

HSDC could be a leader of all Vietnam in sewerage system.

2-2 Review of Existing Condition 1

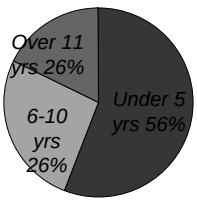
•Schedule (5days each)
1st : July 12th - 17th
2nd : September 6th - 10th
3rd : September 13th - 17th

•Trainees
- 35 people from 16 cities
- 24 - 52 years old
- A wide variety of back-grounds

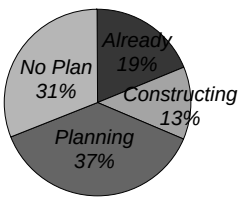
2-2 Review of Existing Condition 2

●Trainees' Diversity

➢Years of Experience at Sewerage & Drainage Company



➢Introduction of WWTP Into Cities



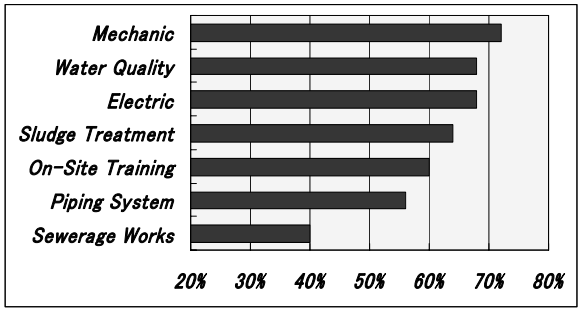
2-2 Review of Existing Condition 3

•Trainers
- 4 people selected by HSDC
- Experts of Sewerage Management, Water Quality, Electrics, and Mechanics
- Their first experience as a trainer

•Program
- Desktop Lectures from each trainer
- On-Site Trainings at 3 WWTPs

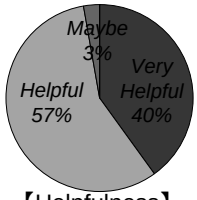
2-2 Review of Existing Condition 4

•Interesting Topics for Trainees

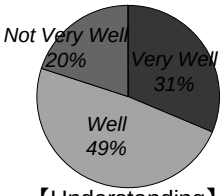


2-3 Findings Through the Course 1

- Strong Points
  1. Helpful for most trainees
  2. Trainees' well understanding
  3. Gradual improvement of trainers' lectures
  4. Networking among trainees and trainers



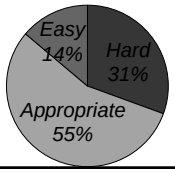
【Helpfulness】



【Understanding】

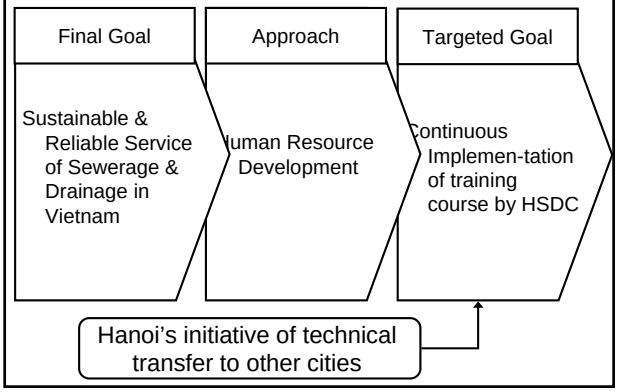
2-3 Findings Through the Course 2

- Weak Points
  1. Difference of each trainee's ability
  2. Insufficiency of each trainer's ability
     - Lack of experience as a trainer
     - Need to develop training skills & further knowledge
     - Cannot cope with upper level as it stands

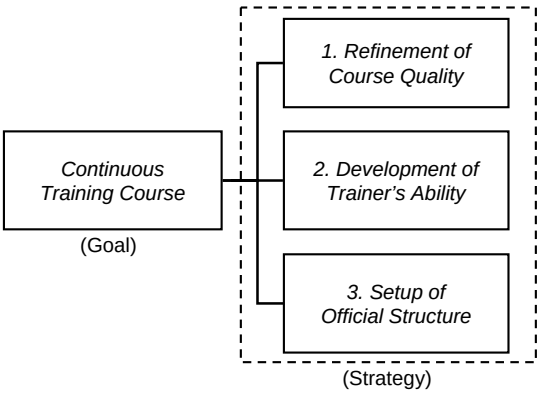


【Trainees' Impression of This Course】

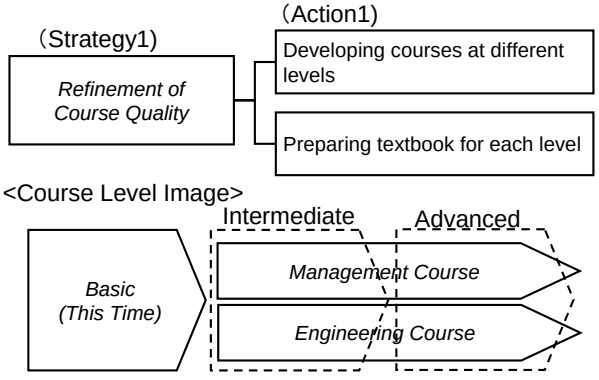
2-4 Targeted Goal



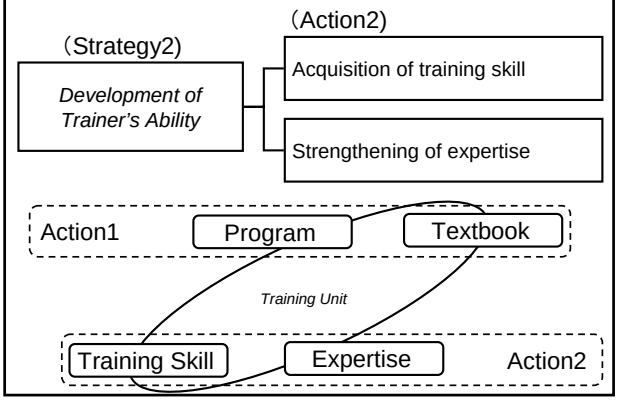
2-5 Strategy for Targeted Goal



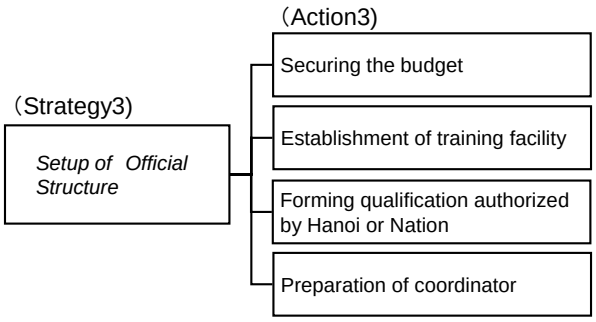
2-6 Action for each strategy 1



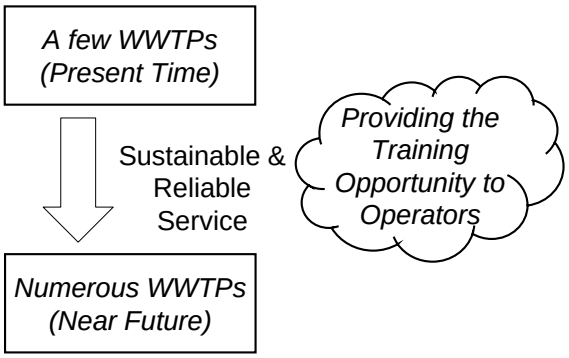
2-6 Action for each strategy 2



2-6 Action for each strategy 3



2-7 Conclusion



TASK 3

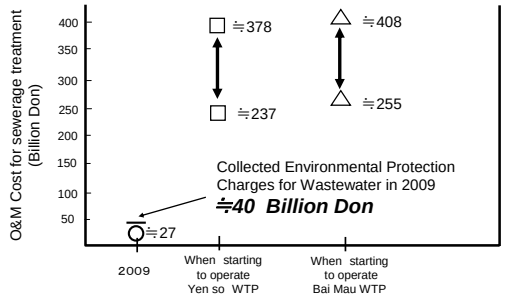
Betterment of O&M anticipating PPP

Contents

Contents

3-1 Review of Current Conditions

Foresight of O&M Cost For Wastewater treatment in Hanoi



3-1

3-1 Review of Current Conditions

ORIENTAL CONSULTANTS CO., LTD. Global Consulting W.Q. HELS CORPERATION

Anticipated Shortage of O&M Cost By Collecting Sewerage Charge

	Now	When starting to operate Yen so WTP	When starting to operate Bai Mau WTP
Charge	≒ 40 Billion Don		
O&M Cost (↑ ↓)	≒ 27 Billion Don	≒ 237 Billion Don	≒ 255 Billion Don
		≒ 378 Billion Don	≒ 408 Billion Don
Shortage (↑ ↓)	—	≒ 197 Billion Don	≒ 215 Billion Don
		≒ 338 Billion Don	≒ 368 Billion Don

3-2

3-2 Anticipated Solutions

ORIENTAL CONSULTANTS CO., LTD. Global Consulting W.Q.

Anticipated Solutions For Shortage of O&M Cost

1. Review of Tariff
2. Review of Cost Reduction on O&M
3. Review of Cost Reduction on Sewerage works with PPP (Public-Private Partnership)

3-3

3-2 Anticipated Solutions

ORIENTAL CONSULTANTS CO., LTD. Global Consulting W.Q. HELS CORPERATION

1 Review of Tariff

Understanding of accurate O&M Cost

Cost For Rainwater → Subsidy

Cost For wastewater → Tariff

Cost For Construction → Subsidy OR Tariff

Determination

3-4

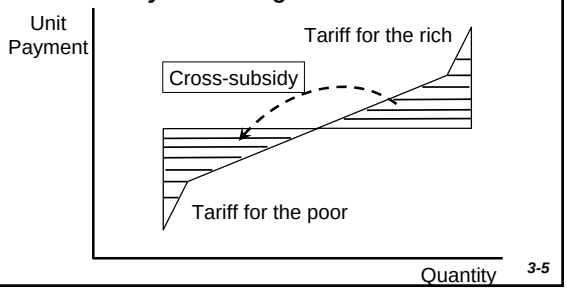
3-2 Anticipated Solutions

ORIENTAL CONSULTANTS CO., LTD. Global Consulting W.Q. HELS CORPERATION

If the calculated tariff is so high

⇒ **Decide it to consider following items**

- Cross-subsidy increasing block tariff structure



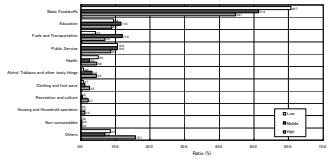
3-5

3-2 Anticipated Solutions

ORIENTAL CONSULTANTS CO., LTD. Global Consulting W.Q.

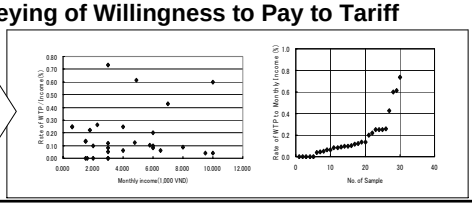
- Understanding of Household Expenditure

Example



- Surveying of Willingness to Pay to Tariff

Example



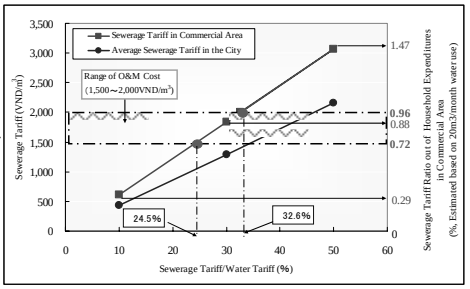
3-6

3-2 Anticipated Solutions

ORIENTAL CONSULTANTS CO., LTD. Global Consulting W.Q.

-Considering Tariff ratio out of Household Expenditures

Example



3-7

3-2 Anticipated Solutions

ORIENTAL CONSULTANTS CO., LTD. Global Consulting H.Q. HELS CORPERATION

2 Review of Cost Reduction on O&M

- Operation
- Maintenance
- Organization

3-8

3-2 Anticipated Solutions

ORIENTAL CONSULTANTS CO., LTD. Global Consulting H.Q.

3 Introduction of PPP (Public-Private Partnership) on Sewerage works

- Introduction of Private Management System
- Introduction of Private Techniques for O&M
- Introduction of Private Finance for Repairing, Renewal and New Facilities

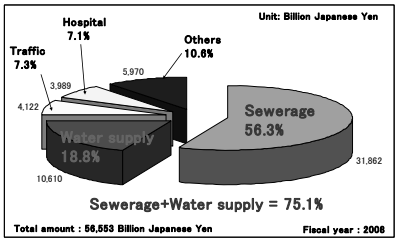
3-9

3-3 Trends of PPP in Other Countries

ORIENTAL CONSULTANTS CO., LTD. Global Consulting H.Q.

Introduction of PPP in advanced countries

Increase of bond issuance ⇨ Fragile financial condition To local government



Example : The balance of Japanese Public Enterprise Bond in 2008

3-10

3-3 Trends of PPP in Other Countries

ORIENTAL CONSULTANTS CO., LTD. Global Consulting H.Q.

Renewal & Repair Costs — Lack — Investment

Fragile financial condition To local government ⇨ Needs Of Private Fund & Techniques

⇩ Decrease of New Recruitment

⇩ Decrease & Aging of Engineers

3-11

3-3 Trends of PPP in Other Countries

ORIENTAL CONSULTANTS CO., LTD. Global Consulting H.Q.

Introduction of PPP (Public-Private Partnership)
- On Legal Point of view with Private Participation

Not allowed	Partially allowed		Only private
Netherlands Only Contract Operation	Finland A few result of Concession	Belgium Various types	England・Wales Full Privatization In 1989
	Germany, Greece, Islands, Italy, Scotland - In recent years, Privatization		
	France, Spain - Long history in PPP	Luxembourg, Japan - Complete law	

3-12

3-3 Trends of PPP in Other Countries

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Not allowed	Partially allowed		Only private
	Australia, America - A few of Privatization	Korea - BTL in Sewer	
	Austria - For the Reduction of subsidy	Denmark, Sweden -Promoting Complete privatization	

3-13

3-3 Trends of PPP in Other Countries

Introduction of PPP in Developing Countries

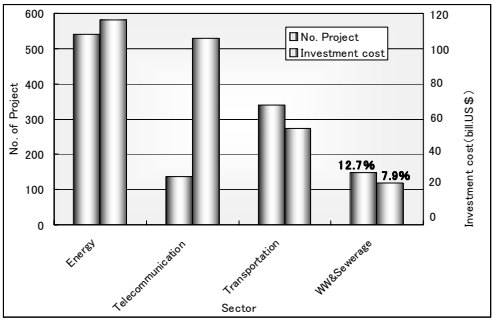
1. **Securing Initial Investment**
2. **Supplementing Technology & Know-Hows**
3. **Early Achievement of Improvement**

Introduction of **PPP (Public-Private Partnership)**

3-14

3-3 Trends of PPP in Other Countries

PPP projects in Asia(1998-2005)



3-15

3-3 Trends of PPP in Other Countries

China

1. **A lot of ROT & BOT**
2. **Introducing Private Technology & Know-Hows**
3. **Early Achievement of Improvement**

Philippines

Privatization of Water & Sewerage works in Manila metro area

Service index	MWSS(1992-1996)	Private contractors(1997-2001)
Population served by piped water	Increasing by 5 % for 5 years	Increasing by 30 % for 5 years
Number of connection	Increasing by 4.5 % for 5 years	Increasing by 30 % for 5 years
Fitness of water quality	90 %	99 %
Time of water supply on an average	17 hours/day	21 hours/day
Not-charged water	61%	57%
Increase rate of connection to sewer	Less 1 %/year	2.7%/year
Number of staffs per 1,000 cocks	9.8 persons	4.1 persons

3-16

3-4 Suggestion of PPP in Hanoi

Objects of PPP Introduction
On Sewerage Works in Hanoi

1 Reduction of O&M Cost with Private Efforts

① Introduction of Private Management System
② Introduction of New and Effective O&M Technology

2 Procurement of Insufficient Fund

① Repairing, Renewal, Upgrading of Sewer
② Construction of New Facilities

3 Early Achievement of Planned Sewerage Works

① Speedy Achievement of Environmental Improvement
② Speedy Improvement of Human Living Conditions

3-17

3-4 Suggestion of PPP in Hanoi

Implementation of New Works Model with PPP
For Existing Facilities

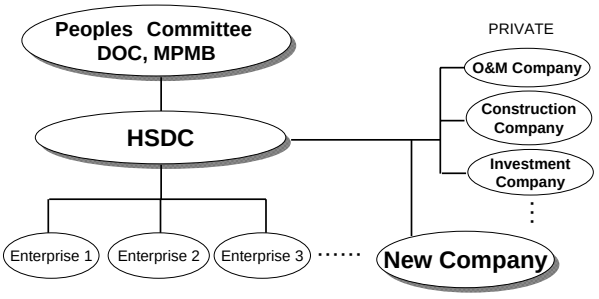
Now
1. Single-year Contract
2. Only Operation and Maintenance

New Model
1. Long-Term Management Contract (10-20 years) with O&M, Repairing, Renewal and Upgrading of Sewer
2. Proposal-scheme Methods
3. Introduction of Private Techniques and Private Fund Infusion for No.1
4. Establishment of New Company for New Works Model

3-18

3-4 Suggestion of PPP in Hanoi

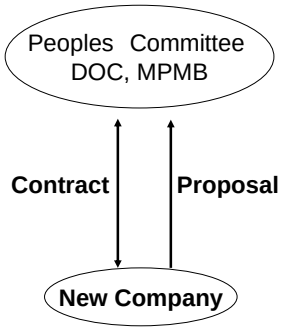
Example : Establishment of New Company for New Methods



3-19

3-4 Suggestion of PPP in Hanoi

Example : Methods of Contract

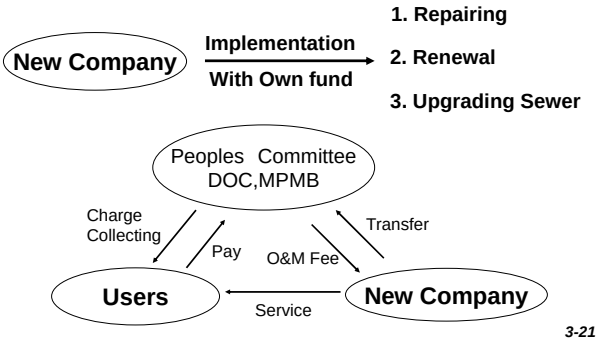


Long-term Contract

1. **O&M**
2. **Repairing**
3. **Renewal**
4. **Upgrading Sewer**

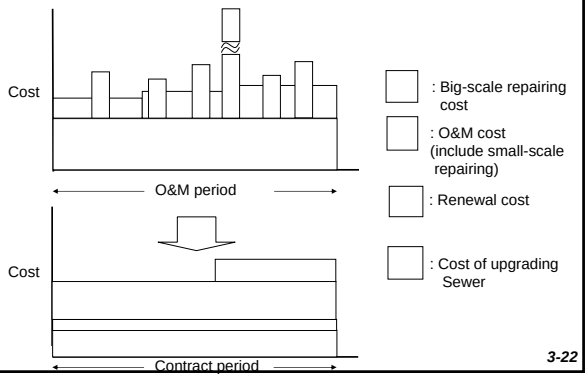
3-4 Suggestion of PPP in Hanoi

Example : Methods of Implementation



3-4 Suggestion of PPP in Hanoi

Image of Cost Reduction and Equalization of Cost



3-4 Suggestion of PPP in Hanoi

Implementation of New Works Model with PPP For New Facilities

Now: **Design** ⇨ **Building** ⇨ **O & M**

Separated Order System

Suggestion

Design → Building → O & M + **Private Fund**

Package Order System（DBO）

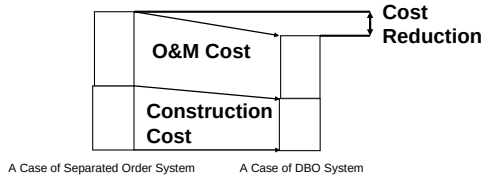
Package Order System（DBFO）

3-4 Suggestion of PPP in Hanoi

Objects to Introduce DBO、DBFO System

1 Reduction of Total Works Cost

① Effective Design with Introduction of Operator`s Opinion
② Introduction of Effective Design, Construction and O&M to Reduce Total Cost



3-4 Suggestion of PPP in Hanoi

Objects to Introduce DBO, DBFO System(2)

2 Clearness of Obligation By Packaged Order System

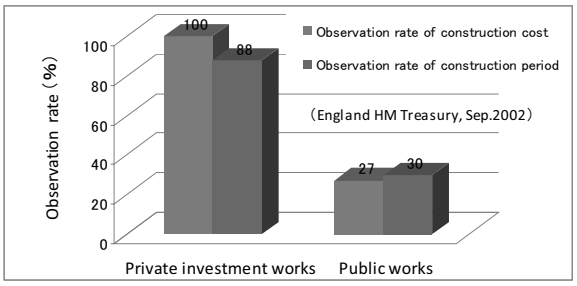
① By Introduction of Penalty System

3 Inhibition of Construction Cost Increasing & Observation of Construction Period

① By Clearness of Obligation
② By Introduction of Penalty System

3-4 Suggestion of PPP in Hanoi

Example : The comparison of the compliance rates of construction cost and period



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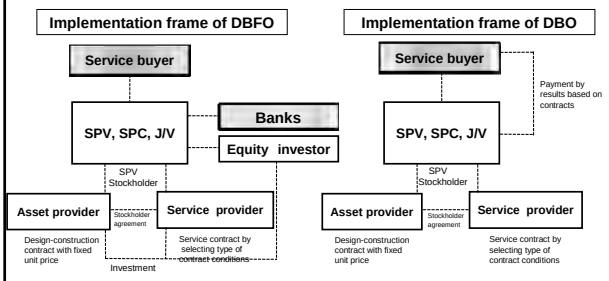
3-4 Suggestion of PPP in Hanoi

Ordinary Implementation Structure of DBO & DBFO



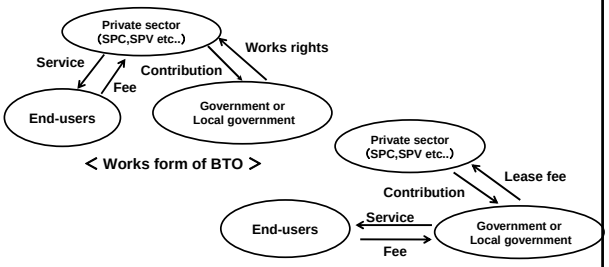
Reference：Palmer,K.,"Contract Issues and Financing in PPP/PFI-Do We Need the F' in DBFO Projects"? Prepared for the IPPR Commission on Public Private Partnerships, 2000, 13-15p.

3-27

3-4 Suggestion of PPP in Hanoi

Implementation of DBFO System in Hanoi

Suggestion | Modified BTO System Such as BTL



3-28

3-4 Suggestion of PPP in Hanoi

Modified BTO System Such as BTL

The Reason of Suggestion

1 Low Tariff

Impossibility of Investment Recovery By Tariff Such as BTO

2 Low Risk for the Service Provider

① Invest Recovery With Lease Fee From Government

② Guarantee of Appropriate Provider`s Profit

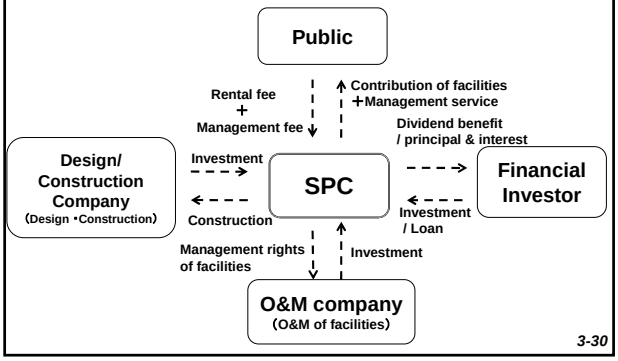
3 Payment of Lease Fee During Long-Term

Light Financial Burden of Government

3-29

3-4 Suggestion of PPP in Hanoi

Ordinary Structure of BTL System



3-30

3-5 Actions to be taken

3-31

1 **Review of Tariff**

1. **Evaluation of Accurate O&M Cost**
2. **Determination of Subsidy Items for O&M Cost**
3. **Research of Cross-Subsidy System**
4. **Surveying of Household Expenditure**
5. **Surveying of Willingness to Pay to Tariff**

Suggestion of Appropriate New Tariff System

3-5 Actions to be taken

2 Review of Cost Reduction on Sewerage works with PPP (Public-Private Partnership)

1 Implementation of New Works Model with PPP For Existing Facilities

- Review of Model Works

- Selection of Model Works
- Review of Outline Cost of Works
- Estimation of Efficiency

3-32

3-5 Actions to be taken

2 Review of Cost Reduction on Sewerage works with PPP (Public-Private Partnership)

1 Implementation of New Works Model with PPP For Existing Facilities

- Review of Legal and Financial Issues

- Review of Consistency with Existing Regulation
- Review of Needs for New Regulation
- Review of Appropriate Structure of New Company

- Review of Adequate Works Scheme

3-33

3-5 Actions to be taken

2 Implementation of DBO & DBFO System For New Facilities

- Review of Detail Works Frame

- Review of Legal and Financial Issues

- Review of Consistency with New PPP Regulation
- Review of Consistency with Other Vietnamese regulation
- Review of Needs for New Regulation
- Review of Appropriate Profit Of Private Provider in DBFO

3-34

3-5 Actions to be taken

2 Implementation of DBO & DBFO System For New Facilities

- Evaluation of Effectiveness

- Selection of Model Works
- Review of VFM for Model Works
- Risk Analysis

- Prepare Contract Forms and Tender Documents

3-35

3-6 Roadmap for Actions to be taken

1 Review of Tariff

		2011						
		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.
1	Evaluation of Accurate O&M Cost	→							
2	Determination of Subsidy Items for O&M Cost		→						
3	Research of Cross-Subsidy System			→					
4	Surveying of Household Expenditure	→			→				
5	Surveying of Willingness to Pay	→			→				
6	Review of Appropriate Tariff							→	→

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3-6 Roadmap for Actions to be taken

2 Review of Cost Reduction on Sewerage works with PPP (Public-Private Partnership)

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1 Review of New Works Model with PPP For Existing Facilities

	2010	2011					
	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.
-Review of Model Works	→							
-Review of Outline Cost of Works	→							
-Review of Legal & Financial Issues	→	→	→	→	→	→	→	→
-Review of Adequate Works Scheme	→	→	→	→	→	→	→	→
-Submission of Adequate Works Scheme to HPC								→

3-6 Roadmap for Actions to be taken

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2 Review of DBO & DBFO System For New Facilities

2011

Jan.	Feb.	Mar	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.

- Review of detail Works Frame of DBO, DBFO
- Review of Legal & Financial Issues
  - Review of Consistency with New PPP Regulation
  - Review of Consistency with Other Vietnamese regulation
  - Review of New Regulation Needs
  - Review of Appropriate Profit Of Private Provider in DBFO

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3-6 Roadmap for Actions to be taken

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2 Review of DBO & DBFO System For New Facilities

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2011

Jan.	Feb.	Mar	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.

- Evaluation of Effectiveness
  - Selection of Model Works
  - Review of VFM for Model Works
  - Risk Analysis
- Prepare Contact Forms and Tender Documents
- Submission of Adequate DBO,DBFO Scheme to HPC

3-6 Roadmap for Actions to be taken

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1 Implementation of New Tariff

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2011	2012	2013	2014

1. Review of New Appropriate Tariff
2. Conducting The Hearing
3. Final Review & Determination of New Tariff By Peoples Committee
4. Approval of New Tariff By Peoples Committee
5. Implementation of New Appropriate Tariff

3-6 Roadmap for Actions to be taken

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2 Implementation of New Works Model with PPP For Existing Facilities

3-41

2011 (Jan.- Jun.)	2011 (Jul.- Dec.)	2012 (Jan.- Jun.)	2012 (Jul.- Dec.)

1. Review of Adequate Works Scheme
2. Final Review & Determination of New Works Model By Peoples Committee
3. Establishment of New Joint Company
4. Contract of New Works Model
5. Start of O&M By New Joint Company

3-6 Roadmap for Actions to be taken

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3 Implementation of DBO & DBFO System For New Facilities

2011	2012	2013	2014

1. Review of Adequate Works Scheme
3. Final Review & Determination of New Works Model By Peoples Committee
4. Approval of New Works Model By HPC
5. Selection of DBO, DBFO Model Works
6. Public offering of DBO, DBFO Model Works

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3-6 Roadmap for Actions to be taken

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3 Implementation of DBO & DBFO System For New Facilities

2013	2014

7. Selection of Service Provider
8. Contract with Selected Service Provider
9. Implementation of Model Works with DBO(DBFO)

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3-7 Necessary Support

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1 Necessary Support For Review of Tariff

1. **Reference of Income & Expenditure for Sewerage Works**
   - Detail Income data (Charge, Subsidy, Collecting Rates, Others)
   - Detail Expenditure data (Construction, O&M, Repayment for Debts, Others)
2. **Permission and Cooperation for Surveying**
   - Surveying of Household Expenditure
   - Surveying of Willingness to Pay

3-7 Necessary Support

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2 Necessary Support For Review of Appropriate PPP for Hanoi

- Holding a Periodic Meeting For Common Conscious
- Co-Work with Counterpart Team
  - Tariff
  - PPP for Existing facilities
  - PPP for DBO
  - PPP for DBFO

3-7 Necessary Support

ORIENTAL CONSULTANTS CO., LTD.

2 Necessary Support For Review of Appropriate PPP for Hanoi

- Information Provision
  - Detail Construction & O&M Cost of Each Exiting STP
  - Master Plan for Improvement of Hanoi
  - F/S Reports for New STPs

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SUMMARY

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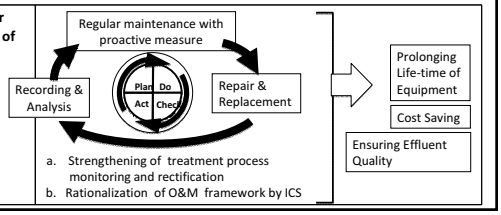
TASK-1 Facility Inspection Results

SWOT analysis

STRENGTHS	WEAKNESSES
• Well established O&M framework • 5 year experience	• Luck of operation data records • Luck of rectification cycle
OPPORTUNITIES	**THREATS**
• Improvement of reliability of O&M performance by promotion of PDCA cycle	• Lack of capability to accommodate the service expansion with increased service area

PDCA cycle for Improvement of O&M performance



a. Strengthening of treatment process monitoring and rectification
b. Rationalization of O&M framework by ICS

SUMMARY

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HELS CORPERATION

TASK-2 Technical Transfer O&M Skill to other cities

SWOT analysis

STRENGTHS	WEAKNESSES
• Sewerage operators' high motivation to technical learning in many regencies. • Increasing sewerage project	• Luck of opportunity for exchanging experience between sewerage operators
OPPORTUNITIES	**THREATS**
• Advanced city in sewerage operation (such as Hanoi) can assists late regencies for their training of O&M skill.	• Lack of trainer • Lack of budget & place • Need legal support to increase skilled operator

Further level-up of O&M skill

- Extension of capability for sewerage operation in Vietnam by sustained exchange of O&M skills between sewerage operators.
- Establishment of Hub in Hanoi for accumulation of Vietnamese sewerage skills.

Continuation of training course & technical transfer → Provide opportunity to level-up of O&M skill for sewerage operators
Continuation of training course & technical transfer → Accumulation of Vietnamese knowledge for sewerage & drainage operation

SUMMARY

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HELS CORPERATION

TASK-3 Betterment of O&M anticipating PPP

SWOT analysis

STRENGTHS	WEAKNESSES
• High demand of sewerage operation accompanying with increasing sewerage projects.	• Budgetary shortage to accommodate increasing demand of sewerage service
OPPORTUNITIES	**THREATS**
• Opportunity for sewerage development by utilizing potential of private sector.	• Undecided legal support for private sector regarding obligation and incentive

Enhancement of Private Sector's Incentive in Sewerage Project

a. Improvement of profit opportunity of private sector

Present (shared responsibility)
- Design contract
- Construction contract
- O&M contract

b. Additional Contract Form

Traditional measurement contract

Proposal
- Simplifying responsibility to one contractor
- enhancement of contractor's originality and creativity

⇩

Packaging of (EPC+O&M)

Schedule after Wrap-up meeting

A	Wrap Up Meeting	28 Sep 2010
B	Discussion with Mr.Odajima, Director, JICA HQ	Mid. Of Oct
C	Counterparts' Comments on Wrap up meeting to JICA team	14 Oct 2010
D	Submission of Draft Final Report (DFR) to JICA HQ	28 Oct 2010
E	JICA's Comments on DFR to JICA team	7 Nov 2010
F	Submission of Final Report to JICA HQ	16 Nov 2010
G	Translation to Vietnamese & Bookbinding	17-29 Nov 2010
H	Submission of Final Report (Vietnamese) to JICA HQ	30 Nov 2010

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Thank You

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