3.3 Technology Transfer of Leakage Survey to the Counterparts

One counterpart of the Planning Section of PWA Head Quarters, five counterparts of the O & M Department of PWA Head Quarters, one counterpart of the Saraburi Regional Office and two counterparts of the Suphanburi Waterworks were assigned to work closely with the Study Team, throughout the survey period.

One of the objectives of this leakage survey was to transfer the know-hows of handling instruments, as well as the methodology of leakage survey to the counterparts, so that they would be able to prepare a similar program in future.

Saraburi Regional Office was found in possession of main instruments used widely in leakage survey, as listed in Table-11.3. They were the same ones the Study Team intended to demonstrate and fortunately some of the counterparts had used them before. So the demonstration and instruction of handling the instruments were smoothly understood by the counterparts.

Though the instruments were familiar, practical lessons of using them in the field survey had not been given by experienced leakage survey experts before, it seemed. Skillful use of the instruments is essential in bearing effective results, especially with leak sound detectors and stethoscopic bars, as many kinds of sound, resembling leakage sound, disturb right judgment.

In this survey, however, an experienced leakage expert of the Study Team could give practical know-hows to be used in searching for and locating leakage spots to the counterparts, through the field work.

The ultrasonic flow meter used in this survey was promised for donation to PWA after the completion of the study and familiarization with the meter was thought to be important. Practical method of installation and operation was demonstrated in details by the Study Team. The counterparts tried hard in learning them with positive willingness.

In addition to the practical know-hows of field survey, the methods of planning like selecting a survey area in the distribution network were learned by the counterparts.

All of the counterparts, while gaining practical experience, became aware of existing problems of obstacles to be tacked by themselves. Those problems discussed during the survey by the Study Team and counterparts are raised and summarized in Chapter 5.

Table-11.3 INVENTORY OF THE INSTRUMENTS FOR LEAKAGE SURVEY

Saraburi Regional Office

1.	Water Leak Detector (Fuji WL-200)	1 set
2.	Electric Sound Detector (Fuji FSB-4L)	1 set
3.	Metal Locator (Fuji F-80)	1 set
4.	Iron Pipe & Live Cable Locator (Fuji PL-801)	1 set
5.	Non Metallic Pipe Locator (Fuji PL-130)	1 set
6.	Water Pressure Recorder (Fuji DW-4892)	5 sets

4. Survey Result

4.1 Big Block Survey

4.1.1 Flow and Water Pressure

24 hours' flow and pressure patterns measured in the Big Block are shown on Fig-11.11. The minimum flow was 6.0 cu m/hr and the maximum 33 cu m/hr. The minimum pressure observed was 1.2 kg/sq cm around 10-11 a.m. and the maximum pressure 2.1 kg/sq cm at midnight.

The 24 hours' flow into the Big Block was 303 cu m/day, when integrated mathematically.

4.1.2 Leakage Detected

Ten leaking spots were found in the Big Block survey. Three underground leakages were detected by sound during the night and confirmed by digging the next day. Some of the seven other leaks on exposed pipes were sound-detected initially and tracked out while the rest was detected visually.

Cause of the three underground leakage was investigated. A case was found to be caused by corrosion, when the spot was excavated. Of the other two, one was located on a service pipe crossing the roadside canal and another buried under pavement of a private premises and both were inaccessible.

The causes of visible leaks were clear. They were mainly due to deterioration of the stop valves on service pipes, but the leakage was very small like dripping from the taps.

Related to the 6 cu m/h minimum flow, any big leakage accountable for the size of flow was not detected. Difficulty was experienced in the sound detection, because the distribution pipes were laid deep, more than 1.5 m depth, and close to the boundary of private premises.

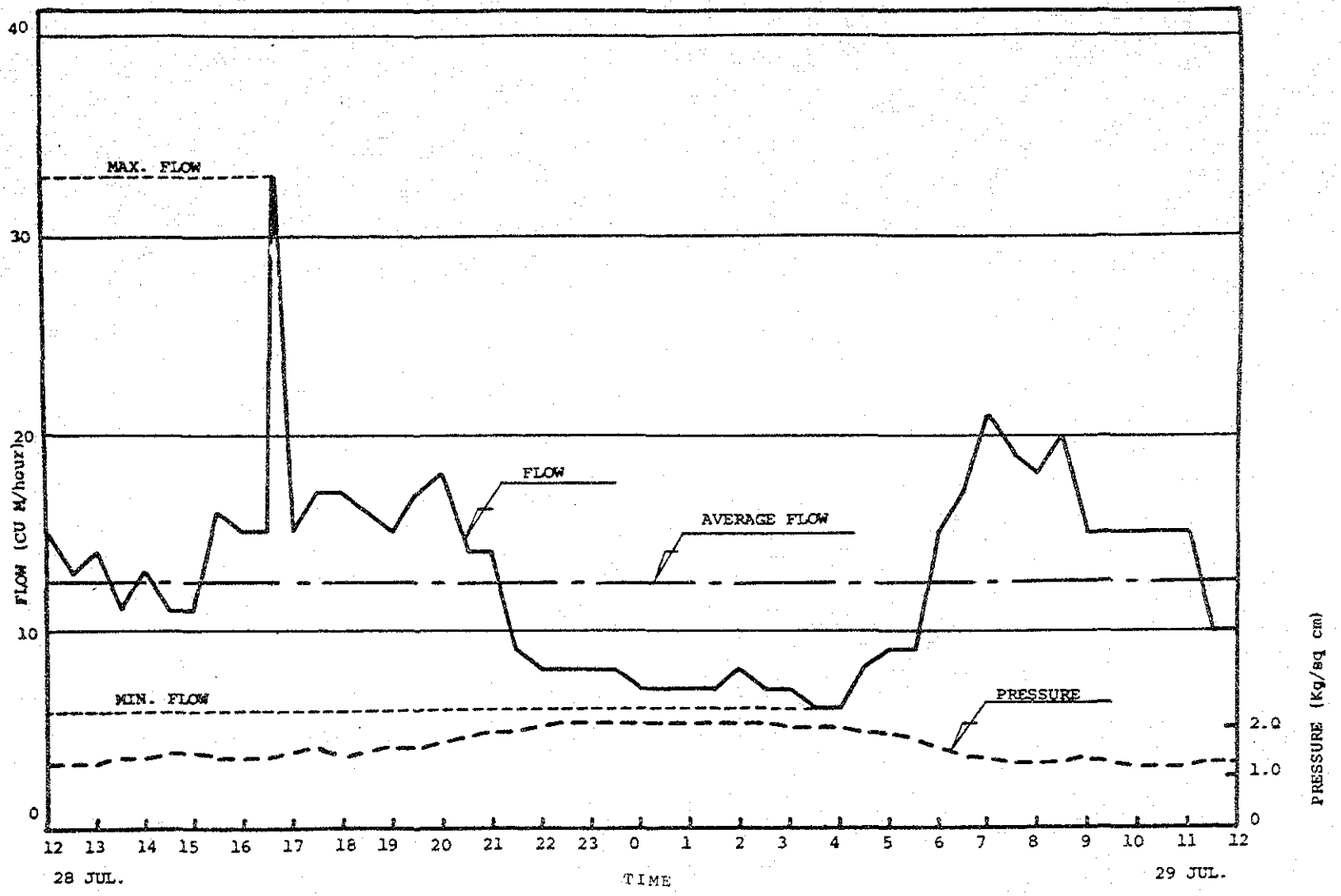


FIGURE	FLOW AND PRESSURE PATTERNS DURING BIG BLOCK SURVEY IN SUPHANBURI
11.11	

JAPAN INTERNATIONAL COOPERATION AGENCY

4.1.3 Leakage Ratio Estimation

Leakage ratio in the surveyed area was calculated, although it was not the sole purpose of this leakage survey.

The minimum flow at midnight was modified upon consideration of the difference of pressure, at midnight and average in the daytime, and it was designated as the leakage loss. The leakage ratio was 41.5 %. Under the average daytime pressure, the leakage per unit pipe length per day was calculated as 78.6 cu m/km/day.

4.2 Small Block Survey

4.2.1 Flow and Water Pressure

24 hours' flow and pressure patterns measured in the Small Block are shown in Fig-11.12. The minimum flow and the maximum flow were 1.0 cu m/hr and 37 cu m/hr, respectively. The minimum pressure was observed at 1.0 kg/sq cm in the afternoon and the maximum pressure was observed at 2.0 kg/sq cm pressure at midnight.

The 24 hours' flow into the Small Block was 133 cu m/day, when integrated mathematically.

4.2.2 Leakage Detected

Four leaking spots were found in the Small Block survey. Two underground leakages were detected by sound during the night. Two leakages on exposed pipes were tracked out.

The main causes of leakage were deterioration of the stop valves on service pipes and fire hydrant.

4.2.3 Leakage Ratio Estimation

The minimum flow was modified upon consideration of the difference of pressure, at midnight and average in the daytime, and it was designated as the leakage loss. The leakage ratio was 16.6 %. Under the average daytime pressure, the leakage per unit pipe length per day was calculated as 31.6 cu m/km/day.

4.3 Summary of Survey Results

The results of both Big Block Survey and Small Block Survey are summarized in Table-11.4.

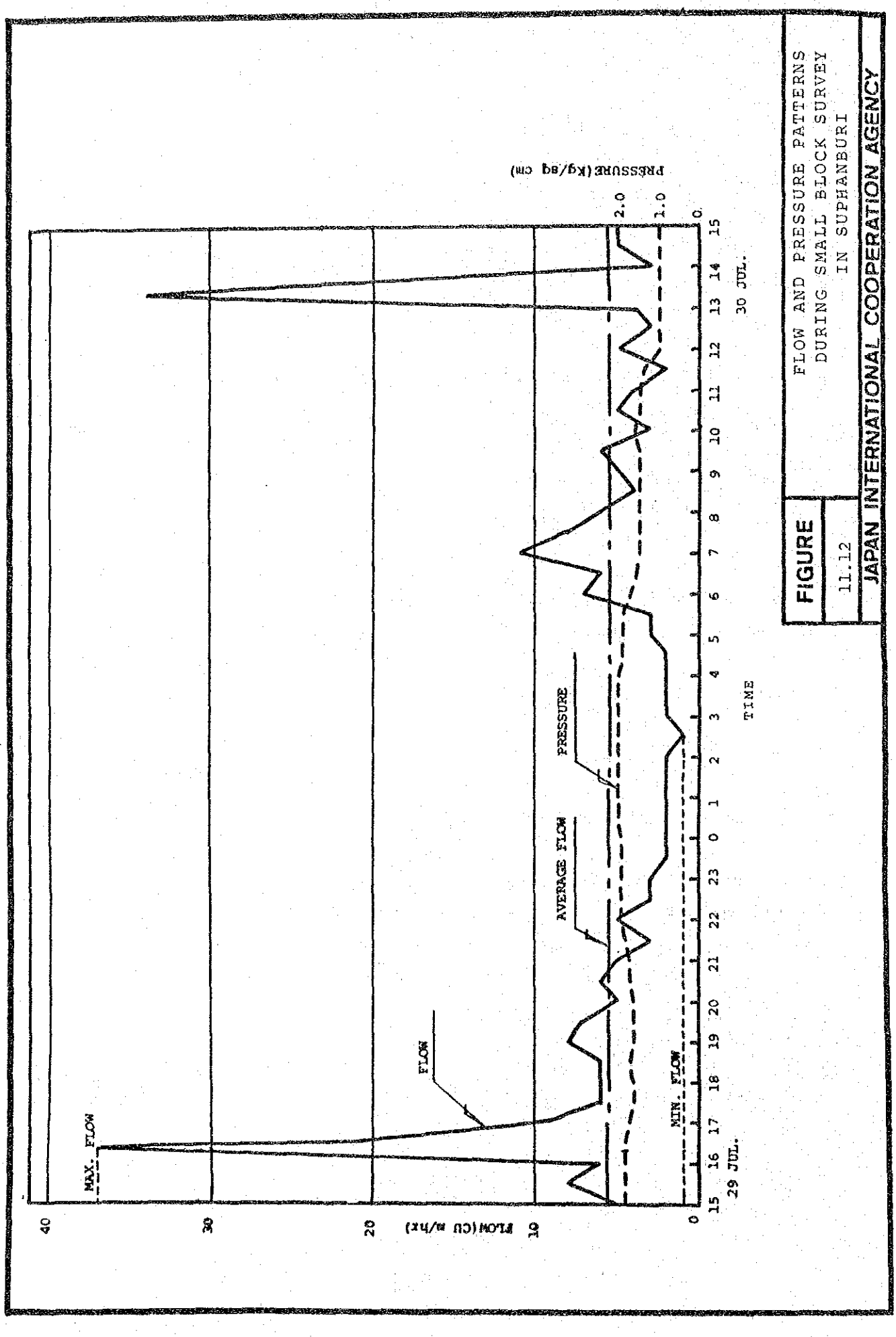


FIGURE 11.12

FLOW AND PRESSURE PATTERNS DURING SMALL BLOCK SURVEY IN SUPHANBURI

JAPAN INTERNATIONAL COOPERATION AGENCY

Table-11.4 SUMMARY OF SURVEY RESULTS IN SUPHANBURI

	ITEM OF RESULTS	UNIT	BIG BLOCK	SMALL BLOCK
A	LENGTH OF DISTRIBUTION PIPE	(km)	1.6	0.7
B	NUMBER OF HOUSE CONNECTION	(number)	230.0	85.0
C	MAXIMUM FLOW	(cu m/hr)	33.0	37.0
D	MINIMUM FLOW	(cu m/hr)	6.0	1.0
E	AVERAGE FLOW	(cu m/hr)	12.6	5.5
F	ACCUMULATED FLOW	(cu m/day)	303.0	133.0
G	MAXIMUM PRESSURE	(kg/sq cm)	2.1	2.0
H	MINIMUM PRESSURE	(kg/sq cm)	1.2	1.0
I	AVERAGE PRESSURE	(kg/sq cm)	1.6	1.7
J	AVERAGE WATER FLOW PER PIPE LENGTH PER HOUR	(cu m/hr/km)	7.9	7.9
	* * * * * ASUMING : MINIMUM FLOW = LEAKAGE * * * * *			
K	MODIFIED LEAKAGE BY AVERAGE PRESSURE	(cu m/hr)	5.2	0.9
L	LEAKAGE AMOUNT PER DAY	(cu m/day)	125.7	22.1
M	ESTIMATED LEAKAGE RATIO	(%)	41.5	16.6
N	LEAKAGE PER PIPE LENGTH	(cu m/day/km)	78.6	31.6
O	LEAKAGE PER HOUSE CONNECTION	(cu m/day/con.)	0.5	0.3

NOTE : F = E x 24
J = E / A
K = D x SQR(I / G)
L = K x 24
M = (L / F) x 100
N = L / A
O = L / B

5. Finding and Conclusion

Major findings of the survey are described as follows:

1) The most pressing problem of the distribution pipes seems to be frequent pipe burst of the main from the Phophraya Treatment Plant to the site of the Dab Fafhun Deep Well. It has happened almost once a month recently.

This main was installed in 1966 and the material is ACP Class 15. During this leakage survey this main burst again.

As the people living near the problem pipes tell, repair works are undertaken immediately by the waterworks. As it happens sometimes, lots of difficulties shall be overcome when the pipes are buried under housing. Inadequate conditions of the tools and implements for repair works make the matter worse.

2) The distribution pipes were laid rather deeply and some of them were located under buildings (especially in commercial area). Such a situation is obviously inconvenient for the maintenance.

3) Only one drawing (1:10,000) of the distribution networks is available. It dose not show some of the new pipes, valves and fire hydrants. It is recommended to prepare complete and updated drawings not only for leakage survey but also routine maintenance and future expansion plan.

4) Some valves are deteriorated. Leakage is observed at the gland of valves when they are operated.

5) Some service pipes are often found to be laid above ground and the old ones are badly corroded. Aggravated corrosion is recognized on the pipes especially laid alongside the sewer flumes.

6) Some fire hydrants are found inoperable because of deterioration of the valves.

7) A few service pipes crossing the road were found to be laid very shallow and exposed partly on the pavement. They will be damaged by the traffic.

8) Ten leak spots were found in the Big and Small Surveys and their causes are considered to be as follows:

Cause	Case
Corrosion	1
Loose or inappropriate joints	1
Deteriorated valve of service connection	4
Deteriorated valve of distribution pipe	1
Deteriorated valve of fire hydrant	1
Unknown (not investigated as described in 4.12)	2

9) In Table-11.4, Item J designates the average water flow per hour per unit pipe length. When the value is larger, the probability of occurrence of leakage is considered to be higher.

For the Big and Small Blocks, the values were 7.9 and 7.9 respectively.

Another indicator is the number of connections per unit pipe length, calculated by dividing Item B by Item A in the table and expressed in the unit of number/km. Again, the larger value suggests the higher probability.

For the Big and Small Blocks, the values were 143 and 121 respectively.

Collecting such data of various waterworks will be helpful in studying leakage problems comparatively and in making a guideline in future.

10) The leak volume calculated by the following formula is indicative of a pipeline's leakage condition:

$$Q = (Q_m / L) \times (P_s / P)^{1/2}$$

where, Q = Leak volume per hour per unit pipe length, (cu m/hr/km)

Q_m: Measured minimum flow per hour, (cu m/hr)

L : Distribution pipe length in the surveyed area, (km)

P_s: Standard water pressure, (2 kg/sq cm)

P : Water pressure when the minimum flow is recorded, (kg/sq cm)

After Q_m and P are measured, Q is calculated with the given L and P_s.

Q values were 3.8 and 1.4 respectively for the Big and Small Blocks. In case of the waterworks in Japan, the value from 0.5 to 1.2 is seen often and considered as acceptable.

There is technical and economical limits in reducing leakage. Setting up its own indicator as calculated above is realistic for each waterworks, upon consideration of existing management, technical level of detection and repair of leakage, staff's availability and capability, benefit of leakage reduction for conservation or development of water sources, future expansion plan, etc.

APPENDIX 12

OPERATION AND MAINTENANCE OF THE SYSTEM

APPENDIX 12

APPENDIX 12 OPERATION AND MAINTENANCE OF THE SYSTEM

12.1 Introduction

The raison d'etre of the water supply service is supplying clean and low-price water in abundance to consumers, in order to improve the public hygiene and promote the living environments. Operation and maintenance of the water supply system aim to realize the reason of the existence.

The water supply service shall manage a public enterprise, by utilizing water sources, a natural and national resource, and supplying potable water to the general public. The service, therefore, has responsibility for utilizing the resource effectively and managing the enterprise soundly.

As for to the service, the people shall pay attention to maintaining cleanness of the water sources and normality of water supply facilities as well as supporting the waterworks management.

Looking as above, cooperation of the supply service and consumers is essential.

12.2 Software and Hardware of Water Supply Service

The water supply service shall be looked into of the two sides, software and hardware. The software is institutional matters such as laws, acts and regulations, while the hardware is physical matters like facilities and equipments.

For the improvement of operation and maintenance, good establishment of the software and hardware is essential.

12.3 Laws

In order to develop the water supply service in a country, the following laws, among others, shall be legistrated and enforced:

For protection and conservation of water sources to be used by the service, laws of Water Pollution Control, Groundwater Control and Natural Environment Protection are needed.

Corresponding with advancement of a country, systematic and organized development of water resources becomes essential. For it, Water Resources Development Law will be effective.

To establish the position of water supply service, Water Supply Service Law is to be legistrated.

To secure employment of competent personnel for the service, a law concerning Status of Public Servants will have to established in coordination with Labor Law.

In Criminal Law stipulation of the crimes of damaging waterworks' facilities, pollution or poisoning water source and stealing water is necessary.

In some countries, illegality concerning the service can be corrected only by means of judicial action. On the part of the service, it is too complicated and troublesome. Instead, the service shall be authorized to take administrative actions like compulsory investigation and penalization. Details of such actions empowered to the service shall be determined and legalized.

Legally and administratively and on both the national and local levels, the water supply service shall be coordinated to other public services such as city planning, road maintenance and housing. Legal and administrative adjustment between the water supply and other services is needed.

12.4 Hardware-oriented Software

Industrial Standards ruling the materials and products used widely and commonly shall be established. The water supply service will benefit by it, as they are used also by the service.

Waterworks Standards applicable to materials and products used by the water supply service are to be prepared.

Design Criteria shall be revised and updated periodically, not only by the staff assigned to the design department/section but also participated by the staff to the departments/sections of procurement, planning and construction, as well as operation and maintenance.

Regarding the above mentioned Industrial Standards, Waterworks Standards and Design Criteria, academic fields' people are to be asked to give advice and private sectors' involvement, by manufacturers, suppliers and contractors, are to be welcomed.

12.5 Organization

A water supply system consists, by the widely accepted concepts, raw water intake and transmission, treatment, distribution and service, following the flow of water.

Usually the waterworks organization is formed after the above division. Upon the local conditions, two or three divisions can be merged to one, for instance, a system using well water may have a division managing intake/transmission/distribution or another system, small sized, will have a division handling distribution/service.

In a large city where it is divided into a number of reasonably-sized districts, the water supply service may have the district office. For such a setup, the district office deals with meter-reading and tariff-collecting, as well as taking technical care of service facilities.

In whatever way a waterworks is organized, a few essential matters are to be considered.

12.5.1 Personnel Management

Assigning the right persons to the right positions is most essential for any organization.

In every aspects of personnel management, fairness is to be regarded. In recruitment, promotion and reshuffle, selection based on the qualification

and past performance of capability and personality shall be made on competitive basis. Favoritism and nepotism shall be avoided by any means.

Aside from the responsible department/division for the matters of personnel, a committee making selection or decision or recruitment, promotion and reshuffle is to be formed in the organization.

In operation and maintenance of a water supply system, the knowledge learned by experience is as valuable as the theoretical technology learned in school. Therefore, experienced technicians shall be given a fair share of opportunities of being promoted to certain levels. When this kind of promotion is realized often, it will help activate young aspiring technicians and even skilled labors.

This promotion system will also influence favorably the success of training of personnel.

12.5.2 Training

Training courses for all levels and different fields of occupation are to be planned and carried out. Participation in the training course followed by accumulation of experience on the job shall be regarded fairly as a qualification. The qualified persons shall be encouraged to attend to higher level of the training course.

To evaluate and improve the effectiveness of a training course, making examination of the participants shall be practiced. Each one's achievement will be used for awarding a license or qualification which can be referred to in the occasions of promotion or assignment of a new promising position.

In low level training courses, the instructors are to be appointed from not only high officials but also persons who have been promoted from lower rank on the merit as suggested above.

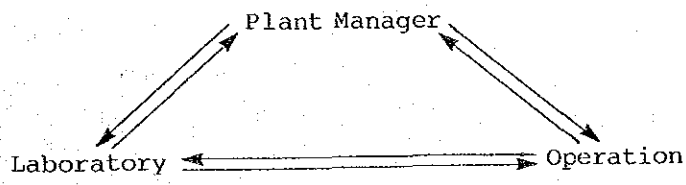
12.5.3 Internal Coordination

In any organization, internal coordination is essential in functioning the whole efficiently and smoothly.

The first point to be stressed is reporting-back or feeding-back of information. In a treatment plant for instance, optimum dosage is determined by the laboratory and reported to the plant manager. The results of actual application of the dosage shall be sent back to the laboratory with comments by the operator, so that, the laboratory is to be learn the difference of mechanical and hydraulic conditions between jar testing and plant performance.

Regarding the whole system, internal feed-back between the divisions of intake/transmission, treatment, distribution and service is to be routinized.

The second point is, so to speak, horizontal coordination as shown below.



From the rule of organization, the plant manager is the coordinator. When different or conflicting information is reported to him from below, he has to adjust, harmonize and decide. However on the daily routine matters, difference can be settled between the interested parties by themselves, partly contradicting the rule of organizational functioning.

In the operation and maintenance of treatment plant and whole supply system, such horizontal coordination or exchange of information is speedy and efficient, and it accords with the first point mentioned before.

As shown above, the way of thinking will make three channels of two-way communication in the picture. Generally speaking, multi-channel, vertical and horizontal two-way communication is to be activated.

12.5.4 Recording and Record Processing

The procedures of recording and record processing shall be ruled within an organization.

Operation and maintenance records, for each of intake/transmission, treatment, distribution and service, are to be made in specified formats, regarding the daily routine works.

Formats of reporting accidental matters are to be prepared also.

Record processing means creating higher-level information by coordinating and integrating the collected records. In the beginning, the methodologies shall be agreed by the participants from different departments/divisions and the aims of using the higher-level information shall be clarified.

12.5.5 Checklists for Preventive Maintenance

Preventive maintenance is most essential. Sensing and correcting abnormality of facilities and equipments, at earlier stages, will certainly end in saving substantial cost of maintenance.

It shall be perceived and tried into everyday's works, by all staff from the top to the bottom. Especially the senior and middle level personnel are expected to contribute, as they are experienced and knowledgeable.

Formats of checklists on the facilities, equipments and machineries which need periodical checking are to be prepared.

12.6 Hardwares for Operation and Maintenance

Hardwares needed in the operation and maintenance are outlined.

12.6.1 Manuals

Manuals covering the following subjects, among others, are needed*

- pipeline
- valve and valve operation
- pumps and appurtenance
- water treatment machinery
- chemical system and operation
- filter operation
- clear water reservoir operation
- leakage survey and repair
- consumers' meter

12.6.2 Maps, Drawings and Ledgers

Maps of pipelines including the location of valves, air valves, drain valves, hydrants and others, are to be kept, in sufficient number and good order and, when any modification works are made on the pipelines, the maps shall be revised immediately. The location of auxiliaries is often found lost when looked for and detailed maps showing the location, relative to permanent structures, are to be attached. The approximate depth of pipes and auxiliaries is to be filled in these maps preferably, when opportunities of finding them occur.

Drawings of the major facilities are also to be revised when modification is made on them.

In principle, materials and devices, design and installation works of private plumbing systems shall be, all of them, under the control of the waterworks authority. For each plumbing system, a ledger shall kept in file.

The documents are to be made in duplicate or triplicate, depending on the importance of them, and to be kept in file in the waterworks, regional office and head office.

12.6.3 Vehicles

Considering the work volume and number of personnel engaged in various tasks of operation and maintenance, vehicles like bicycles, motorbikes, vans, trucks and sedans are to be allocated for the use of waterworks.

Mobility is a key matter in operation and maintenance works.

12.6.4 Communication system

Communication system between the waterworks office, treatment plant, pumping station, operation/maintenance chief's office and the field staff team is to be made immediately when need arises. Public telephone system shall be fully utilized for the communication and a radio system between a mobile station and fixed station will be effective.

For a large plant or where offices are set apart in a large site, an in-plant telephone system is to be installed, because frequent exchange of information is preferable, as mentioned in 12.5.3 previously.

Assuming various cases of emergency, communication plan shall be prepared well beforehand.

12.6.5 Meters and Meter Management System

a service meter is said to become inaccurate after about 6 years of service. It will mean that 16 % of existing meters is to be replaced by new or renewed ones. If additional requirement for new customers is counted, about 20 % of the presently installed number shall be kept ready for use in the warehouse.

A meter management system is to be established, as well as the stockpiling

of meters. As the hardware parts of the system, warehouse, repair shop and meter-testing shop will be needed.

12.6.6 Simple Monitoring system

A simple monitoring system, by a number of testing devices and with the help of the waterworks personnel and citizens, is to be formed.

The devices are portable pressure gauges, residual chlorine testers and hand-made turbidity meters consisting of pre-made test tubes of standard turbidity.

The portable pressure gauge is a model which is inserted to the household tap, pushed and held by hand for measuring pressure.

The residual chlorine tester is the widely used kit, containing chemical, small test tube and rotating disc of color comparison.

The turbidity meter consists of a few test tubes. To each of them, a set of standard turbidity, for example, 1,2,4,8 and 16 ppm, is prepared by laboratory, contained and sealed. A sample of unknown turbidity is compared with them for rough estimation of turbidity.

Selecting the participants of the monitoring system shall be made on the location of their houses, points of collecting informative data, and capability in handling the testers. The participants will be the laboratory workers of knowledge and experience, engineers of the waterworks, citizens such as school teachers of chemistry and engineering, and well learned persons working in the fields of science and engineering.

The participants are to test water of their taps on the pre-fixed timing periodically. The collected data showing various spots' water quality and pressure are to be plotted on the map, to overview the service area's condition.

The kind of citizens participation will help promoting the public relations.

12.7 Public Relation

In the foregoing sections, the issues related to improve operation and maintenance of the waterworks have been discussed, mostly from the standpoints of water supply service.

Some of the issues cannot be achieved without the support and cooperation of the pubic.

12.7.1 Legal and Administrative Issues

In 12.3 the following laws were named and explained of the necessity:

- Water Pollution Control
- Groundwater Control
- Natural Environment Protection
- Water Resources Development
- Water Supply Service

Also discussed in 12.3 was that the water supply service shall be empowered administratively to make compulsory investigation and penalizing actions against illegality concerning the water source and supply service.

Regarding the above, strong support of the public is necessary.

12.7.2 Public Enlightenment

The water supply service shall be positive in enlightening the public on the necessity of clean water, taking opportunities of involving in school education, civilian and women groups' activities.

As a form of excursion, the primary and secondary school children can visit the water intake and treatment plant to learn about water supply service. For higher educational institutions, sending the waterworks staff to give lectures on the subject like waterworks engineering, water pollution control and others will be fruitful.

On the occasions of festival and recreational events, the waterworks shall take advantage of them for campaigning its cause and activities.

12.7.3 Personnel in the Front

The meter readers, tariff collectors, service system repairmen and receptionists in the office make direct contacts with the customers.

They shall be nice and kind so that customers can speak out opinion on the supply service freely. Some of the customers viewpoints will be helpful for improvement of the service and these well-intended people shall be asked for more help in future.

Like awarding the informers of illegal connection, awarding the people detecting leakage on the public pipeline is worth studying, as it will save the works of operation and maintenance staff. The same can be applied to the case of finding faulty meters.

The customers are to be taught of making simple repairs by themselves. It will also save inefficient input of manpower on the part of waterworks.

In case of accidents needing major repair works, the damages inflicted on the private property shall be immediately compensated. Delayed action on such matters will damage the public relation as well as the waterworks image.

12.7.4 Advance Notice

The date of the meter readers' and tariff collectors' visit to the consumers shall be noticed in advance. Or, more preferably, a certain date is fixed on each specific section of the service area.

Advance notices are also needed in the case of pipeline works which cause failure or shortfall of supply to consumers. The purpose, date, time and duration of the works and foreseeable inconvenience shall be informed.

APPENDIX 13

SCOPE OF WORK

APPENDIX 13

Minutes of Meeting

SCOPE OF WORK
FOR
MASTER PLAN
AND
FEASIBILITY STUDY
ON
PROVINCIAL WATER SUPPLY PROJECTS
IN
THE KINGDOM OF THAILAND
AGREED UPON BETWEEN
PROVINCIAL WATERWORKS AUTHORITY
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

BANGKOK, 1985

細田三朗

Saburo HOSODA
Leader
JICA Preliminary Study Team

Dr. Tawat Wichaidit
The Governor
Provincial Waterworks
Authority

I. INTRODUCTION

In response to the request of the Government of Thailand, the Government of Japan decided to implement a Master Plan and a Feasibility Study on Provincial Water Supply Projects (Chiangmai, Ubon-Ratchathani, Suphanburi and Pattaya) in Thailand (hereinafter referred to as "the Study") within the general framework of technical cooperation between Japan and Thailand, which is set forth in the Agreement on Technical Cooperation between the Government of Japan and the Government of Thailand, signed on November, 1981.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programme of the Government of Japan, will undertake the study, in accordance with the relevant laws and regulations in force in Japan and in close cooperation with the authorities of Thailand. The Provincial Waterworks Authority (hereinafter referred to as "PWA") shall act as counter agency to the Japanese Study Team and also as a coordinating body in relation with other relevant organizations for the smooth implementation of the study. The present document sets forth the Scope of Work for the study.

II. OBJECTIVE OF THE STUDY

The objective of the study is to prepare a Master Plan (long term basic plan) for the Provincial water supply projects in Chiangmai Municipality and its Surrounding Communities Sansai, San-Kamphaeng, Saraphi and Hang Dong, Ubon-Ratchathani Municipality, Warin Chamrap Municipality Suphanburi, and Pattaya up to the next 20 years, (2006) and to carry out a feasibility study (short term development plan) for a project selected from the result of the Master Plan study.

S.H

III. OUTLINE OF THE STUDY

The Study will be composed of field surveys and data collection in Thailand and of analysis works in both Thailand and Japan.

The items to be covered by the Study are as follows:

(i) Phase I; Master Plan Study (Long term basic plan)

a. Data collection and analysis
b. Delineation of served areas for planning
c. Projection (estimation of population and Water demand etc.)
d. Study of existing water supply system (facilities, Management, and Organization etc)
e. Study of water sources (based on the available data)
f. Planning of appropriate water supply system (Organization, Operation and Management Plan)
g. Rough estimation of cost for construction, operation and maintenance
h. Preparation of implementation program
i. Identification of the project including immediate improvement and rehabilitation for the Feasibility Study.

(ii) Phase II; Feasibility Study (Short term development plan)

a. Delineation of project area
b. Estimation of population to be served
c. Estimation of water demand
d. Study of improvement of existing facilities
e. Study of water sources
f. Layout of facilities
g. Study for alternative plans

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h. Preliminary design (including design criteria)
i. Study of construction materials and labour force
j. Estimation of costs of construction, operation and maintenance
k. Preparation of Construction method and procurement method of materials and equipments
l. Study of Tariff System
m. Estimation of benefits
n. Economic Studies and Financial analysis
o. Study of organization, operation and management plan
p. Preparation of implementation schedule.

IV WORK SCHEDULE

The study will be conducted in accordance with the tentative schedule as shown in the Annex I herewith attached.

S.H

V. REPORTS

JICA shall prepare and submit the following reports in English to the Government of Thailand.

1) Inception Report
   - Copies 30
   . at the beginning of the Field Survey (Master Plan Study)

2) Progress Report
   - Copies 30
   . at the end of Field Survey (feasibility study)

3) Interim Report
   - Copies 30 each
   . within 3 months from the beginning of the Master Plan Study
   . within 7 months from the beginning of the Feasibility study

4) Draft Final Report
   - Copies 30
   . within 10 months from the beginning of the feasibility study

5) Final Report with summaries
   - Copies 50 each
   . within 16 months from the beginning of the Master Plan study
   . within 13 months from the beginning of the Feasibility study

The PWA shall submit her comments to JICA within one month after the receipt of Draft Final Report.

S.W

VI. UNDERTAKING OF THE GOVERNMENT OF THE KINGDOM OF THAILAND

1. In accordance with the Agreement on Technical Cooperation between the Government of Japan and the Government of the Kingdom of Thailand dated November 5, 1981, the Government of the Kingdom of Thailand shall accord benefits to the Japanese study team as follows:-

(1) to permit the members of the Japanese study team to enter, leave and sojourn in Thailand for the duration of their assignment therein and exempt them from alien registration requirements and consular fees,

(2) to exempt the members of the Japanese study team from taxes, duties and any other charges on equipment, machinery and other materials brought into Thailand for the conduct of the Study,

(3) to exempt the members of the Japanese study team from income taxes and charges of any kind imposed on or in connection with any emolument or allowance paid to the members of the Japanese study team for their services in connection with the implementation of the Study,

(4) to bear claims, if any arises against the members of the Japanese study team resulting from, occuring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Japanese study team.

S.H

2. To facilitate smooth conduct of the Study, PWA shall take necessary measures in cooperation with other relevant organization;

(1) to secure permission for entry into private properties or restricted areas for the conduct of the Study,

(2) to secure permission for the study team to take all data and documents (including photographs) related to the Study out of Thailand to Japan.

(3) to provide the medical services as needed (Its expenses will be chargeable on members of the Japanese study team),

(4) to ensure the safety of the members of the Japanese study team when and as it is required in the course of the Study.

3. PWA shall, at its own expense, provide the Japanese study team with the followings:

(1) available data and information related to the Study,

(2) counterpart personnel,

(3) suitable office space with necessary equipment,

(4) credentials or identification cards.

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VII. UNDERTAKING OF JICA

For the implementation of the Study, JICA shall take the following measures,

(1) to dispatch, at its own expense, study teams to Thailand,

(2) to pursue technology transfer to the Thai counterpart personnel in the course of the Study.

VIII. JICA and PWA shall consult with each other in respect of any matter that may arise from or in connection with the Study.

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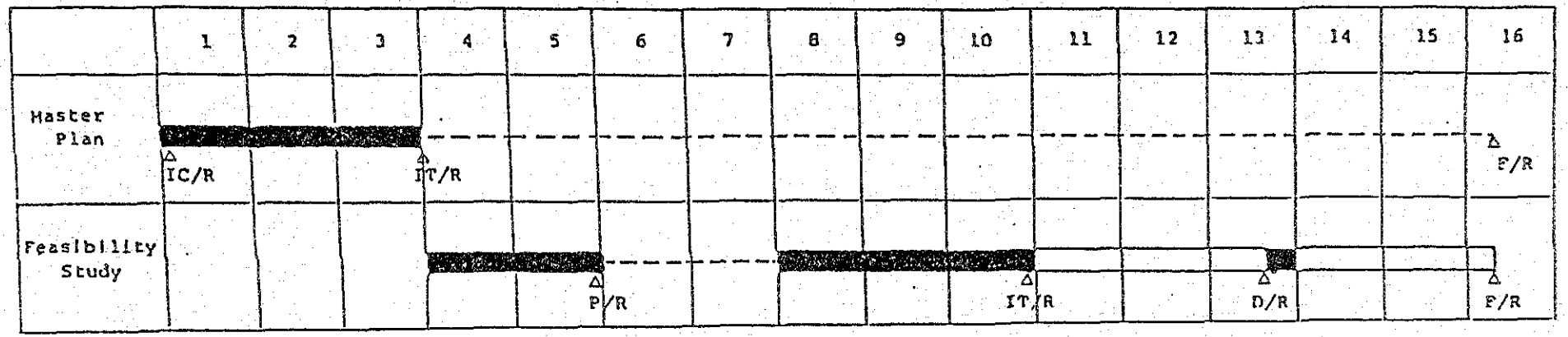
ANNEX I Tentative Schedule for Master Plan, Feasibilisy Study



* Remarks ■ in Thailand
□ in Japan

IC/R Inception Report
P/R Progress Report
IT/R Interim Report
D/R Draft Final Report
F/R Final Report

MINUTES OF MEETING

ON

THE SCOPE OF WORK FOR THE MASTER PLAN

AND

FEASIBILITY STUDY

ON

PROVINCIAL WATER SUPPLY PROJECTS

AUG. 13, 1985

BANGKOK, THAILAND

細田三朗

Saburo HOSODA
Leader
JICA Preliminary Study Team

DR. TAWAT Wichaidit
The Governor
Provincial Waterworks Authority

MINUTES OF MEETING

The Japanese Preliminary Study Team and the Thai counterpart of PWA held a series of discussions during July 30 - August 13, 1985 concerning the Scope of Work.

The present minutes were prepared to confirm the main issues discussed and matters agreed upon both parties.

A. Both parties confirmed the followings :-

1. Scope of Work

The Japanese Study Team (hereinafter referred to as "the Study Team") shall implement a Master Plan and a Feasibility Study of Provincial Water Supply Projects in Thailand based on available data which the Study Team will study in cooperation with PWA, whose items are shown in Annex I.

(1) The Master Plan will be selected by optimal solution by technical and economical evaluation.

(2) Delineation of served areas for planning will be implemented in consideration of such as economic, geographical and related aspects.

(3) Estimation of water demand will be implemented not only in terms of total demand but also divided in categories such as domestic, institutiona commercial and industrial demand.

(4) The Study Team will implement the water sources studying on hydrological, hydrogeological, geophysical survey etc., based on such available data.
The Study Team will evaluate to determine the availability of alternative water sources.

(5) In Feasibility Study, "Study for alternative plans" will include the selection of optimal plan.

(6) Estimation of benefits of optimal plan will be implemented not only in direct but also indirect aspects such as improvement of human health etc., in general terms.

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(7) Water leakage detection concerning preparation of drawings and systematic detection of pipe bursts, etc., will be surveyed, studied and prepared in "Study of organization, operation and management plan" so that the Water Leakage Detection Program will be implemented by PWA.

2. Undertaking of PWA

PWA shall, at its own expense, provide the Study Team with the followings :-

- Counterpart personnel : 3 Engineers, during the study period
  Non-technical personnel : 1 Clerk (Full Time), 1 Clerk (Part Time)
- Main Office : Space (10 personnels occupied) with necessary equipment
  (Desk, Chair, Locker, Telephone (1) (local use), Air Conditioning, in PWA H.Q.)
  Field Office : Suitable office space with Desk, Chair, etc. at Chiangmai, Ubon-Ratchathani, Suphanburi, Pattaya in PWA Regional Offices

3. Technical Training

PWA requested that her counterparts will be invited to Japan for technical training, Japanese side promised to take the request for favorable consideration.

B : Attendants of the discussions :

1. PWA Side (Corporate Planning Department)
   - Mr. PRAKIT Chanurai
     Acting Chief, Planning Division
   - Miss. ORAPIN Assavanig
     Chief, International Cooperation Section
   - Mr. PRAPON Chanakitjanukit , Engineer
   - Mr. JAROON Upanan , Engineer
   - Mr. SUTHEE Asawapichaid , Engineer

5. 2

2. Japanese Side

- Mr. Saburo HOSODA
  Director of Riverhead Forestory Office, Bureau of Waterworks, TOKYO METROPOLITAN GOVERNMENT
- Mr. Yoichi SEKI
  Special Advisor to the Director, Social Department, JAPAN INTERNATIONAL COOPERATION AGENCY
- Mr. Tsutomu NAGASAKA
  Engineer, Atsuta Office, NAGOYA WATERWORKS BUREAU
- Mr. Masuji IDE
  Engineer, Northern Water Control Center, YOKOHAMA WATERWORKS BUREAU
- Mr. Hajime NISHIKAWA
  Engineer, Water Supply Division, MINISTRY OF HEALTH AND WELFARE

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Annex I

I. Importance of the Project

(1) Relationship between the budget and the Relevant Development Plan.
(2) Utilization Plan of technical transfer
(3) Priority, urgency of the Project
(4) Advantageous effect
(5) Solved problem

II. Outline of four cities

(1) Data
- Hydrology
- Climate
- Geography

(2) Type of cities
(3) The movement of population and economics
(4) Order of importance of the cities
(5) Arrangement of electricity supply, water supply and drainage situation
(6) Characteristics
(7) Public health

III. References

PWA

(1) Laws and regulations
(2) Purpose of activity
(3) Organization
(4) Management situation
(5) Budget plan

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(6) Future plan
(7) Outline of PWA's undertaking
(8) Process of decision making of budget and policy

Four cities

IV. Outline of four cities's waterworks
(1) Statistics of facilities
(2) Statistics of population and water demand
(3) Served area
(4) Present situation of the waterworks facilities
  a. Intake facilities
  b. Conveyance, water transmission, distribution and service installation
  c. Purification facilities
  d. Maintenance of facilities
  e. Water sources
(5) Prospects of future water works facilities (in details)
(6) Technical Standard
(7) Water rate system
(8) Budget plan
(9) Technique period, cost of construction

V. Present evalution of waterworks (including analyses of causes)
(1) Technique (man-power)
(2) Management system waterworks
(3) Stock of equipment, existance of repair works factory
(4) Situation of finance
(5) Management plans for improvement

VI. Relation with other administrative organizations

VII. Adjustment of map drawing in projected area
(1) Map of topography, etc.
(2) Drawing of facilities
(3) Drawing of piping
(4) Process chart for facilities

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VIII. Existing problem in PWA

IX. Technical and economical cooperation by foreign countries or international organizations in recent years in relation with waterworks

X. Others

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APPENDIX 14

OFFICIALS CONCERNED IN THAILAND

APPENDIX 14

APPENDIX 14 OFFICIALS CONCERNED IN THAILAND

Provincial Waterworks Authority

Dr. Tawat Wichaidit	Governor
Mr. Sawasdi Orvichian	Deputy Governor
Mr. Anant Tantidhamma	Deputy Governor
Dr. Wanchai Ghooprasert	Assistant Governor

Corporate Planning Department (CPD)

Mr. Chatpong Chucharoen	Director
Mr. Sukhon Sitthilertpisan	Acting Chief, Planning Division
Miss Orapin Assavanig	Chief, International Cooperation Section
Mr. Prakit Chanurai	Acting Chief, Policy and Planning Work
Dr. Sarawoot Chayovan	Chief, Water Resources Development Project
Mr. Wanchai Lowatanatrakul	Project Coordinator, Corporate Planning Division
Mr. Thaworn Nitipavachon	Water Resources Development Project
Mrs. Pinporn Phongsri	Corporate Planning Division
Miss Wirawan Kaeopradith	Corporate Planning Division
Mr. Jaroon Upanan	Corporate Planning Division
Mr. Somkriat Piriyakakul	Water Resources Development Project
Mr. Udomsak Siriaksorn	Water Resources Development Project
Mr. Sanit Kitchawan	Corporate Planning Division
Mr. Suthee Asawapichaid	Corporate Planning Division
Mr. Pisit Hongvanishkul	Corporate Planning Division
Mr. Piray Satayasunhusakul	Corporate Planning Division
Mr. Nived vachiraanan	Corporate Planning Division
Mr. Prathom Khoysomboon	Corporate Planning Division
Mrs. Anu Songsakchai	Corporate Planning Division
Mrs. Bussara Rasamiamornwiwat	Corporate Planning Division
Mr. Prapon Chanakitjanukit	Corporate Planning Division

Operation and Maintenance I

Mr. Virusah Mahakkapong	Director
Mr. Wiroon Pungronothanin	Chief, Water Production Section
Mr. Veerapun Henprasert	
Mr. Pichai Pirapaemakul	
Mr. Sombun Kheawchalua	
Mr. Sommai Tossila	
Mr. Phichai Pirapatanakul	

Operation and Maintenance II

Mr. Sitthichai Pissathanporn	Director
Mr. Wuthichai Usaha	Chief, Water Distribution Section
Mr. Prasong Nimwattana	
Mr. Surachai Jarikhuan	
Mr. Chuer Panyasiri	
Mr. Ruthai Intarapalit	

Accounting and Finance Department

Mrs. Virayu Amornlectrakul	Director
Mrs. Vanida Taechasaen	Chief, Accounting Division
Miss Sompis Amornrodjanawong	Head, Loan Account
Miss Chantira Chulothok	Head, General Ledger
Mrs. Somsong Pantaranontaka	Acting Director, Budget Division

Analysis and Evaluation Department

Miss Chindarat Suwanabhat	Chief, Data Collection and Reporting Section

Engineering Department

Mr. Anunt Sahasak	

Central Laboratory

Mrs. Chitra Tritham	Head, Chemical Section

Suphanburi

Mr. Chalermvong Nitipavachon	Director, Regional Office No.2
Mr. Saard Saipring	Head, Technical Service, Regional Office No.2
Mr. Anon Munjanabat	Manager, Suphanburi Waterworks
Mr. Kowit Taengprasert	Head, Service Section, Suphanburi Waterworks
Mr. Apichat Mesaye	Suphanburi Waterworks

Embassy of Japan

Mr. Yasunobu Takayama	First Secretary

JICA Bangkok Office

Mr. Motonori Gotoh	Representative
Mr. Shin-ichi Suzuki	Deputy Director
Mr. Takahito Hino	Assistant Resident Representative

JICA Expert

Mr. Masaru Tanaka	Provincial Waterworks Authority
Mr. Kumpei Igarashi	Provincial Waterworks Authority

APPENDIX 15

MEMBER LIST OF ADVISORY COMMITTEE AND STUDY TEAM

APPENDIX 15

APPENDIX 15 MEMBER LIST OF ADVISORY COMMITTEE AND STUDY TEAM

Advisory Committee

Mr. Saburo Hosoda (Chairman)	Director, Riverhead Forestry Office, Bureau of Waterworks, Tokyo Metropolitan Government
Mr. Tsutomu Nagasaka	Nagoya Waterworks Bureau
Mr. Masuji Ide	Yokohama Waterworks Bureau
Mr. Hajime Nishikawa	Kobe Waterworks Bureau

Ministry of Foreign Affairs

Mr. Teruyoshi Kumashiro	Development Cooperation Division
Mr. Takeo Sato	Development Cooperation Division

Ministry of Health and Welfare

Mr. Syuhei Kato	Water Supply and Environmental Sanitation Department
Mr. Hiroyuki Endo	Water Supply and Environmental Sanitation Department
Mr. Tsutomu Sakagawa	Water Supply and Environmental Sanitation Department

JICA

Mr. Hiroyoshi Ihara	Social Development Cooperation Department
Mr. Shozo Matsuura	Social Development Cooperation Department
Mr. Yoichi Seki	Social Development Cooperation Department, Coordinator

Study Team

Mr. Osamu Wakamoto (Team Leader)	General Director, Overseas Service Department, Nihon Suido Consultants Co., Ltd.
Mr. Hiroshi Machida (Co-Team Leader)	Director, Overseas Service Department Nihon Suido Consultants Co., Ltd.
Mr. Tatsuya Samukawa	Advisor, Overseas Service Department Nihon Suido Consultants Co., Ltd.
Mr. Shigeyoshi Kagawa	Nihon Suido Consultants Co., Ltd.
Mr. Hideki Kondo	Nihon Suido Consultants Co., Ltd.
Mr. Hideki Asada	Nihon Suido Consultants Co., Ltd.
Mr. Toshio Yamada	Nihon Suido Consultants Co., Ltd.
Mr. Masakazu Inamiya	Nihon Suido Consultants Co., Ltd.
Mr. Takemasa Mamiya	Nihon Suido Consultants Co., Ltd.