PURSE PROJECT

Private Participation in Urban Services

TECHNICAL ISSUES PAPERS

- Risks and Their Frequencies, Possible Effects and Their Allocation Between the Two Parties to an Agreement
  PURSE Report No. 12.1.A\96\037-TIP1
- Non-Revenue Water: What it is; What Can be Done About it; and, Who Will Reap the Benefits
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- Issues Concerning the Transfer of Treated Water Between Two or More Private Parties and/or PDAMs
  PURSE Report No. 12.1.C\96\041-TIP5

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BAPPENAS
DEPARTEMEN DALAM NEGERI

DEPARTEMEN KEUANGAN
DEP. PEKERJAAN UMUM

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TECHNICAL ISSUES PAPERS

INTRODUCTION

The five technical issues papers included in this volume have been prepared over the course of the past eight months. They represent the first of what we expect will be an on-going series of presentations, somewhat informal, of issues, problems, and ideas about the development of public-private partnership infrastructure projects as encountered during the course of implementing the PURSE Project.

The purpose of this Technical Issues Papers (TIP) series is to put on the table for discussion and dialogue issues which are important, germane, and perhaps generic to the development of public-private water (and other sector) projects in Indonesia. While not attempting to be fully comprehensive or offering final conclusions or solutions to these issues, the Papers are intended rather to identify problems, share insights and experience, and initiate the problem solving process. We hope that they will serve as a catalyst for further refining the structuring of public-private partnership deals, and improve the project development process.

Although they share the common sectoral theme of water supply, these Papers have been grouped together here in a single volume simply for ease of dissemination. Copies of each may also be obtained individually from PURSE by referring to the specific title and report number.

The reproduction and dissemination of these Papers, and discussion of the ideas they contain, is widely encouraged.

All papers from the PURSE Project's Technical Issues Paper series are also available in translation in Bahasa Indonesia. When requesting a copy, please specify the report number, and language version preferred.

Technical Issues Paper No.1
PURSE Report No.12.1.A\96\037-TIP1
Author: Lindley H. Hall, Municipal Services Advisor, PURSE Project

RISKS AND THEIR FREQUENCY, POSSIBLE EFFECTS AND THE ALLOCATION BETWEEN THE TWO PARTIES TO THE AGREEMENT

Introduction

The purpose of this memorandum is to provide some basic information on the technical risks involved in constructing and operating a public water supply treatment facility, and a water distribution system. However, most of the technical risks have significant "financial risks" associated with them. The purpose is not to differentiate between technical and financial types of risks, but to consider what causes the technical risks and what might be done to control and/or mitigate the effects of occurrences. This may be a basis for discussions with the staff of a PDAM, and later, with the proposed Concessionaires.

Certain risks must be addressed in the *Cooperation Agreement* between the parties; other risks may require that mitigating actions be taken by one or both of the parties. Most of the risks, or possible adverse events, should be addressed by clauses in the *Agreement*, in which the parties would agree on who is to take any specific action to limit the damage or the frequency of re-occurrence. The *Agreement* should also spell out how one party would be compensated for losses due to an event, such as a shortfall in the supply of raw water, which is a "risk" assigned to the other party.

In addition to the risk itself, the other factors of importance are the *impact* of the event - will it cause major damage, or just minor disruption, if it occurs - and the probable or expected *frequency of occurrence*. The importance of addressing each specific risk and the financial importance of taking mitigating action will be largely determined by the expected impacts and the frequency of occurrence. For instance, a lack of raw water for an extended period of time, particularly if it occurs every year, may have a very large adverse impact on the quality of water used by people and their health. Therefore, this type of risk needs to be evaluated and action taken to mitigate the effects, even if the risk is "assumed" by the GOI, and compensation paid to the Concessionaire when any water 'shortfall' occurs.

The "impact" of many events will be a reduction in the amount of water produced, and thus a loss of income from the sale of water. Other impacts may be physical damage requiring repairs, which can usually be covered by insurance (earthquake, fire, etc.). The monetary impact of most of the risk events can be estimated, as can the frequency of occurrence. Such estimated costs can be used to determine the significance of the impact on the overall financial feasibility of the project.

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This ***Technical Issues Paper*** has been written with a "Concession" in mind, similar to that proposed by the Salim Group for the Western Sector of PAM JAYA and Tangerang. If only a management and operation contract is to be undertaken, or a separate organization is to undertake design and construction of certain facilities, then the list of risks involved in the more limited type of contract will probably be shorter.

I have listed those risks I consider to be "technical" in nature, but each directly relates to a cost or financial risk. However, the causes, ramifications and possible mitigating measures are largely within the planning, engineering and facility operational aspects of the project. Other legal and financial risks which do not have a technical component must also be addressed; I have listed some of those types of risks separately.

The following listing is offered for review, and additions and changes are encouraged.

1. **Risk - Inadequate or incorrect design, causing added expense to correct.**
This would have a "minor" type of impact and its frequency of occurrence is not great, due to a one-time design period. The Concessionaire should bear the risk, possibly passing it off to a separate design firm, if the design firm is not part of the Consortium.

   Possible actions to control the risk: Hire a design firm experienced in the water supply field, and require design review procedures be utilized.

2. **Risk - Improper design resulting in less than the expected quality or quantity of water output.**
This would have a minor/medium type of impact, and it would continue to occur until the design flaw(s) were corrected. The Concessionaire should bear the risk, possibly passing it off to the design firm, if the design firm is not part of the Consortium.

   Possible actions to control the risk: Hire an experienced design firm, as noted above. Also, conduct pilot plant studies on existing raw water throughout a full one-year cycle of river flow. Note: the pilot plant studies can continue during initial design work for the treatment facility, as the results of the studies would mainly be used to decide on the chemical treatment processes and chemical feed rates, which can be designed later than the structural and foundation aspects of the project.

3. **Risk - Construction problems causing extra costs.**
This would have a minor to medium impact, and it would only occur during construction. The Concessionaire should bear the risk.

   Possible actions to control the risk: Hire an experienced construction management firm, with local experience. Establish and use project management systems.

4. **Risk - Construction problems causing an overrun on the schedule for completion of the project, and inability to meet water system demands.**
This would have a medium impact, and would occur only during the construction period. The Concessionaire should bear the risk.

Possible actions to control the risk: Same as above. Also, plan for alternative sources of water during a potential short-term period when delay in completion of construction could result in shortfall in the volume of water available to meet demands.

5. **Risk - An inadequate quantity of raw water is available during low-flow conditions.** This would have a medium to major impact, depending upon the frequency of occurrence The impact would also depend upon the availability of alternative supplies of raw or treated water which could meet the demands on the water supply system. The GOI should carry the entire risk, beyond a specified amount of short-fall and length of time of the short-fall; e.g., the Concessionaire may take responsibility for, say, a 10% shortfall in raw water for up to two days, only claiming compensation when the shortfall is greater in amount or longer in duration. However, the Concessionaire should only be allowed compensation when the demand for water is greater than the supply of raw water; if the treatment plant is operating at less than full capacity, and the short-fall in volume of raw water does not directly affect operations, no compensation is justified.

The Concessionaire can take certain actions to mitigate the impacts, and the costs of those mitigating actions may be defined and used as the basis for possible compensation. The GOI may also take mitigating actions, such as diverting irrigation water for urban use.

The costs to the Concessionaire, and the "lost revenue", must be related to the amount of short-fall experienced as the basis for compensation. The *Agreement* should deal with this issue in some detail to reduce the possibility of future misunderstandings or disagreements between the two parties.

Possible actions to control the risk: The best approach to address this significant risk is to complete an adequate hydrogeologic evaluation prior to the decision to award a permit for use of the quantity of raw water required for the project. If an inadequate supply of raw water is identified, then GOI action is necessary to reassign water use rights. An alternative mitigating measure is to provide additional water from groundwater wells, which may be held in "standby" status until those periods when raw water supplies from the surface supply are inadequate. Wells can be pumped at a much higher rate when used for a small percentage of the time, if they are properly designed and installed to permit higher rates of withdrawal.

6. **Risk - the raw water quality is adversely impacted by wastewater discharges.** This may have a minor, medium or major impact, depending upon the amount of deterioration and the length of time during which it occurs. The frequency can be difficult to predict; in the "worst case" it can be continuous and have a major and long-term effect on the quantity and quality of the treated water produced. The Concessionaire will be able to mitigate some effects by adjustment in the treatment process, which may result in some reduction in the output of treated water. The GOI must bear the burden of protecting the water quality to keep it within the limits established at the time of the Feasibility Study water quality tests. The GOI can take action to correct or eliminate wastewater discharges, and to monitor for inadequately treated discharges.

This type of risk must be addressed in some detail in the *Agreement* because of the many factors involved and the challenge in measuring the impact and the basis for any compensation to the Concessionaire.

Possible actions to control the risk: The initial step should be taken during the "Feasibility Study", when the industries located within the watershed (drainage area) of the proposed raw water intake should be identified and the potential types of discharges evaluated. The major action to control this risk, however, is adequate monitoring and enforcement of legal controls by the GOI agencies responsible for water resources.

An operator of a water treatment facility has a need to know when an upstream wastewater discharge has adversely affected the raw water quality. Therefore, a water quality monitoring system should be established to provide information to the operator.

7. **Risk - the raw water quality is adversely impacted by a chemical or water contaminant.**

This impact has a *long-term health impact* not anticipated or monitored during regular operations. The impact will depend upon the type of adverse health impact on people, the reversibility of the impact and the length of time it occurs before detection. The frequency of such an event is very low by historical standards. The Concessionaire has responsibility to monitor raw water and treated water quality in accordance with good practice in the industry, and based upon known risks. The GOI would logically bear the risk of health impacts on the public and the responsibility to identify such health risks, based upon the state of knowledge within and without Indonesia. (An example of this type of risk is the mercury poisoning of fish-eating people in one area of Japan some years ago.)

Possible actions to control the risk: The Ministry of Health should be responsible for controlling this risk, to the extent that it is controllable.

8. **Risk - a chemical spill or other unexpected, one-time event occurs which makes the raw water unusable for a period of time.**

The impact would be major, but the time period may be short or long-term, depending upon the time required to clear the spill beyond the raw water intake. A spill into a reservoir could be extremely severe due to the long time needed to flush most of the chemical out of a large body of water. The frequency will depend upon the type of development within the watershed and the array of possible events which could occur. The Concessionaire can bear the risk of short-term shut-downs, but medium to longer-term events must be a risk borne by the GOI. Mitigating actions can be taken by both the Concessionaire and the GOI, and the actions to be taken by the Concessionaire should be defined, in general terms, in the *Agreement* with the GOI.

Possible actions to control the risk: The Concessionaire should conduct an evaluation of the potential for spills, most likely as part of the evaluation of industries within the watershed. In addition to industrial spills there is some risk of a road accident resulting in a spill of chemicals directly or indirectly into the raw water source. The Concessionaire

can be prepared to take certain actions to control spills or other events, in coordination with the GOI.

9. **Risk - Steady decline in water quality over a period of years due to increasing development and amounts of chemical or domestic wastewater discharges.**

This may have a major impact, but the frequency would be low, as the decline in quality can be identified in time to take mitigating action. The Concessionaire should have the responsibility (bear the risk) for identifying the deterioration of water quality and notifying the GOI of necessary action to alleviate the problem. The GOI should be responsible for preventing and controlling the problem before it adversely affects the quantity and quality of the treated water output. The management of this risk is necessarily a joint responsibility and the tasks assigned to each party should be spelled out in the agreement.

Possible actions to control the risk: Both parties should monitor the water quality to identify any problem so that any needed action can be taken.

NOTE: The present deterioration of water quality in the reservoirs upstream of Jatiluhur are one variation of this type of risk. The present situation could cause significant future problems in the raw water quality of Jatiluhur. The seriousness of the potential risk is accented by the fish kills now reported at the upstream reservoir when wind causes lower strata of water to come up to the surface layer.

10. **Risk - Operational Problem due to mechanical or electrical failure, fire, accident,etc.**

The impact may be minor or medium, or even major if it puts the plant out of operation for an extended period of time. The frequency of all except minor operational problems should be very low, particularly if design, management, operation and maintenance are all within the parameters of good utility practice. The Concessionaire should bear all the risk for anything which is caused by a factor within the plant or within his control. Operational problems caused by outside events will usually be under 'force majeure' rules.

Possible actions to control the risk: The Concessionaire will control the risk through good design, effective safety and operational programs and good management. The GOI should consider requiring the Concessionaire to provide an operational risk evaluation, listing those design and operational requirements to be employed to reduce the impact of any adverse event. Examples: A major electrical fire in the main control room; flooding of the treatment plant - how would each be prevented and/or handled.

11. **Risk - Disruption of operation due to interruption of chemical supply, electrical power, etc.**

The impact should be minor, perhaps medium at most, as the disruption should be correctable within a reasonable length of time. The frequency may depend upon political and other factors outside the control of the Concessionaire, who should be responsible for interruptions normally expected in the line of business. The GOI should be responsible for those interruptions over which it has control, such as the interruption of chemical

imports when adequate supplies are not available from Indonesian firms. The risks should be defined and assigned as part of the *Agreement*.

Possible actions to control the risk: The Concessionaire should consider the advantages of installing adequate electrical generation capacity to meet all operational needs; plus, the storage of an adequate emergency supply of chemicals and supplies required to operate for a reasonable period of supply interruption.

12. **Risk - Force Majeure.**

The definition can have two parts - firstly, those caused by nature; secondly, those caused by people - both of which are events beyond the control of the Concessionaire. Natural events, such as earthquakes, volcanic eruptions and storms, are predictable in a general sense and any damage can be the responsibility of the Concessionaire, except when a catastrophic event destroys a large part of the water system. Physical damage due to a catastrophic event, such as a major earthquake, should be a risk carried by the GOI, or both parties, to the extent the risk cannot be shared through insurance. Disruption of service due to natural events is not the responsibility of the Concessionaire, except when normal precautions to control damage and maintain operations are not taken by him.

Man-made events, including war, insurrection. etc. cannot be predicted as to frequency or impact, and are beyond the responsibility of the Concessionaire. In the *Agreement* specific attention to the responsibility of the GOI to provide physical protection to certain facilities should be spelled out, as water supply is a critical public function to be protected by the GOI.

13. **Risk - Technical Obsolescence.**

The treatment facility and other facilities may become obsolescent due to improvements in technology and/or increases in the level of treatment required by GOI decree. The impacts will be minor, as they occur slowly over time. The frequency will be low - either it will occur during the lifetime of the facility, or it will not occur. The Concessionaire should not be responsible for the risk if it is not anticipated at the time of design and initial operation, and normal utility practice does not include making changes in the facilities to meet higher standards on a routine basis. The risk is the cost of the improvements necessary, or the earlier-than-planned replacement of a process or facility; in this case, the cost of such work should be recognized in the tariff or other compensation. Such contingencies should be addressed in the *Agreement*. Obsolescence caused by changes in requirements which occur during the development-construction period should be the subject of negotiation, as spelled out in the *Agreement*.

14. **Risk - Changes in Environmental Law or Requirements.**

The unanticipated changes should not be the responsibility of the Concessionaire, but should be compensated by a change in the tariff or other payment. The *Agreement* should cover such contingencies and the method for dealing with the financial impacts of such changes.

If the change in the law or requirements occurs during the development and construction period, then a change in design might be feasible, but any additional costs for construction (and possibly operation) should be addressed by a procedure spelled out in the *Agreement*.

15. **Risk - Health Risks to the wider population due to contamination within the distribution system.**

The impact may be minor, medium or major depending upon the type and extent of contamination. Water may be one vector for the spread of a disease, which may also be spread by other means. Frequency of occurrence should be low when the system is operated and maintained by the Concessionaire in accordance with good utility practice. However, events over which the Concessionaire does not reasonably have control, such as cross- contamination from wastewater, should not be his responsibility. The GOI should carry the prime responsibility to monitor the various methods for the spread of disease and the physical and other barriers which exist to prevent the contamination of the water supply.

NOTE: It might be worthwhile for the Concessionaire to take the responsibility to evaluate such risks, identify what should be done and then to inform the PDAM or Ministry of Health, in writing, about the risk. If this is a responsibility assigned to the Concessionaire, it should be stated that this is done only to "assist" the GOI, and the Concessionaire is not taking on the legal responsibility for preventing future problems.

16. **Risk - Competing Supplies or Suppliers.**

The impact of competitors will be minor to medium, depending upon the extent of the inroads into the concession. The use of groundwater in lieu of a piped supply is one major identified "competitor", the control of which is the responsibility of the GOI. Under the *Agreement* the GOI can give to the Concessionaire certain authority to control the use of groundwater. The *Agreement* should address the actions to be taken to control and to monitor the use of groundwater in competition with the concession. The impact of direct competition by another supplier of water should be controlled by the GOI, who is granting the exclusive concession.

17. **Risk - Technical Targets are based on inadequate, incomplete or inaccurate information**

If the *Agreement* is based on "Technical Targets" which must be achieved, and which achievement may affect payment to the PP, then it is important that the individual "targets" can be defined and measured. Secondly, measurement of progress and achievement of the targets is necessary. Inadequate or inaccurate initial information may result in a significantly greater investment to achieve required targets; or it could result in achievement of the numerical targets without the "real" improvements desired by the GOI.

The following are Legal and Financial Risks, which are not related directly to "Technical Risks":

1. Risk - Currency convertibility, profit repatriation and exchange rate changes.

2. Risk - Changes in Government and Abrogation of the Contract.

3. Risk - Inadequate adjustments in the Tariff to reflect Increased costs.

4. Risk - Inflation, if not recoverable in Tariff increases

5. Risk - Changes in laws, inadequate legal framework and dispute resolution procedures.

Technical Issues Paper No. 2
PURSE Report No. 7.3.A\96\038-TIP2
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NON-REVENUE WATER: WHAT IT IS, WHAT CAN BE DONE ABOUT IT, AND WHO WILL REAP THE BENEFITS?

Introduction

This memorandum provides a general evaluation of the "Non-revenue Water" issues for a PDAM that is considering or in the process of develpoing a concession type Public Private Partnership. The issues discussed in this paper were developedfrom the PAM JAYA experience and considers information provided by the JWSSP in their recent "*Water Demands Update Report*", dated September, 1995. The JWSSP has identified a number of factors which will affect the amount of NRW/UFW; they have used estimates for the impact of each factor to adjust the estimates of the future percentage of NRW/UFW for the PAM JAYA system. It should be noted that NRW/UFW is NOT equivalent to the loss of water through leakage, which is only one of many components of the total volume of water for which PAM JAYA does not receive revenue.

The amount of "non-revenue water" (NRW) is high and, if it can be reduced, the potential increases in annual revenue are very significant. It is worthwhile to consider (1) the causes; (2) the potential actions to reduce each of the components: (3) the investments which may be required; (4) the revenues which may be generated by the improvements; and (5) how the improvements in the NRW, as a whole, may be measured.

Overview

"Non-revenue water" (NRW) is that water which is produced, but not sold and paid for by the water system users. It is essentially the same as "Unaccounted-for water" (UFW); however, it also includes water consumed in public facilities but which is not paid for.

The amount of non-revenue water can be basically estimated by comparing (a) the metered flow into the system with (b) the volume of water which is sold and paid for. As a practical matter, the water distribution system for a large city must be divided into sections of reasonable size for evaluation. However, the many interconnected branches of the distribution system make it quite difficult to isolate one defined section of the system to conduct such a test. Additionally, the closing of valves to isolate flow into a section to one metered entry point essentially reduces the pressure within the piping in the section, and the rate of leakage during the time of the test.

The Jakarta Water Supply Sector Project (JWSSP) has estimated that the **1995** "unaccounted-for water" is 514 Million l/day (51%) compared with 494 Ml/d (or 49%) for the water actually sold. In **2005** (10 years from now) they estimate the "unaccounted-for water" will increase to 638 Ml/d, while the water sold will increase to 957 Ml/d (59.9%). Increases are expected due to a number of reasons: an enlargement of the distribution system (more piping) will result in more leakage and other losses, and improvements in pressure and continuity of supply will increase the amount of loss through existing leaks.

If *non-revenue water* can be reduced, it will essentially increase the revenue flowing to the Water Company without the need to invest in more facilities to produce and distribute water. Also, there will be no increase in annual water treatment and other operating costs, other than the costs to achieve the reduction in NRW. Secondly, once any component of NRW is reduced, the increased revenue will continue through the future years, with only some annual expense to ensure the continuing lower level of NRW losses.

There are a number of types of non-revenue water, as discussed in the following section. Action taken to reduce or largely eliminate several of the types of NRW should produce significant results.

It is suggested that, initially, the costs to achieve a reduction in total NRW will be small compared to the revenue gains achieved. After the first several years, however, the remaining *non-revenue water* may be largely the physical losses occurring through many leaks, which will be much less cost-effective to find and correct. Therefore, it is reasonable to assume that the rate of reduction of NRW, year to year, will fall over time.

Types of Non-revenue Water

It is useful to first identify the different types of "non-revenue water", and to then look at each type to consider the possible corrective actions, the costs for corrective actions, and the "rewards" in increased revenue or increased volume of water to be gained.

I have identified the following seven (7) components of NRW:

1. Water supplied to the consumer, but not recorded because of defective metering:

   Meters are mechanical devices which will tend to record less than actual water flow as the internal parts wear. The difference between actual water use and the meter reading will increase from year to year as the wear in the meter increases, thus revenues will steadily decrease. As all meters will tend to develop a problem of "under-recording" the aggregate loss in revenue throughout the system can become significant.

2. Water supplied to the consumer but not recorded due to low rates of flow or a broken meter:

Low flows through the meter may not be recorded, just because of the inertia of the moving parts. The low flows may be due to small leaks in household fixtures which waste water on a continuous basis; or due to routine flow at very low rates into a tub for later use. The amount of water not recorded will result in lower water bills and decreased revenue.

3. Water meter readings are "under-reported" on bills, or bills to not show the amount of water consumed:

Under-reporting of the meter reading results in bills for less than the amount consumed, and a direct loss of revenue.

4. Water supplied to consumers through illegal connections:

There are no meters on illegal connections so the entire amount of water consumed results in lost revenue; also, there is no incentive to reduce water use or fix leaks when it is not being billed, so consumption will tend to be higher through non-metered connections. There is some evidence from past field work that the number of illegal connections is larger than at first anticipated.

5. Water supplied to government, military and other public consumers which is not billed:

Water consumed may be recorded by meters, but if it is not billed and paid for, it is part of NRW. The revenue loss is equal to the value of the water recorded, plus any under-recording due to ageing meters.

6. Water lost through leakage from the Water Company's distribution network:

This is water lost between the point where treated water input is measured (master meters) and the household/consumer meters. It includes both large leaks and small leaks, many of which may be impossible to locate.

7. Water consumed by public functions but not metered, including fires, main flushing, street cleaning and irrigation:

This volume of water is only that taken from the water mains, and does not include water taken from canals and other sources for irrigation and other uses.

NOTES:

1. In addition, there is a certain amount of treated water which is used in the backwashing (cleaning) of the filters at the Treatment Plant. This water should not be included in NRW as only the NET output of the Treatment Plant should be measured at the 'master meters'.

2. A first step must be a check of the accuracy of the "master meters", probably located at the Water Treatment Plants. If the master meters are under-recording, then the volume of NRW is GREATER than now estimated, as actually there is more water being put into the system than is shown on the meters. If so, the return on investment for corrective action may be greater, as larger amounts of lost revenue can be potentially recovered.

How to Address the Types of Non-revenue Water

1. Defective water meters (under-recording due to wear): Replace existing meters, starting with large water users; return old meters to a shop for rebuilding. The cost of new meters is reasonable and, after overhaul in the meter shop, the inventory of "rebuilt" meters should then be used for a continuing program of meter replacement and overhaul. Meters should be replaced and the meter then overhauled after about 8 years in use.

2. Low flows not recorded: Replacement of meters will have some beneficial effect, as new internal parts will record the flow at lower velocities. As continuous low flows are often due to small leaks, education of customers on the need to repair leaks is useful. (Note: customers will generally believe that all water lost through leaks does get recorded and added to their bill, so they should be willing to fix leaks).

3. Water Consumption under-reported on bills: When meters are replaced the new meters can be ones designed for direct reading and recording of information on a hand-held device. When the units are "down-loaded" daily into the main computer system that system will 'capture' the accurate information on the meter number, when the meter was read and the meter reading itself. As prior readings can be stored in the recorder, bills can also be directly produced by the hand-held meter-reading device and handed to the customer. By doing so, any dispute on the reading can be immediately resolved by looking at the meter itself. This good PR approach should reduce "bad debts" due to disagreements on the amount of water consumed.

4. Illegal connections: A program to identify illegal connections can be based upon inspections in the field, augmented by flow measurements into each district when new meters have been installed and a field check for lost water is undertaken.

5. Water supplied to public facilities but not billed: The GOI can make a policy decision on such a direct subsidy, or establish regulations for regular and timely payment for the water that is consumed. In any case, meters should be installed and read on a regular basis, so the amount of lost revenue can be determined and included in reports to management.

6. Water lost through leakage: A number of interrelated actions will be required to locate leaks within the distribution system. Once identified, the decision to repair a water line, or to replace it, can be based upon the overall investment program and the return-on-investment expected. Prior to the investigation water must be provided to consumers

under reasonable pressure, and on a continuous basis, so that water leakage measurement will reflect conditions under the desired level of service The improvements needed to provide continuity of water service will require both time and investment.

The system evaluation steps will include the following:

a. Evaluate the system and determine how individual sections of piping network can be isolated for measurement of water inflow.
b. Replace water meters within each section to obtain accurate water use information.
c. Install inflow metering equipment, measure the water used for one or more periods of time, then analyze the data to determine unaccounted-for water. The history of the distribution system and its problems will be useful to help in identifying which pipes may be in poorest condition or experiencing excessive corrosion.
d. Identify illegal connections and other sources of loss.
e. Utilize listening devices and other techniques to identify larger leaks.
f. Conduct a field investigation, including excavation where visible water flow indicates possible leaks flowing into drains or canals

The large number of minor leaks which develop at most pipe joints and in service lines to customers contribute, in the aggregate, a significant percentage of the total amount lost to leakage. However, it may not be financially feasible to find and fix most of the minor leaks.

Where the overall condition of the system is poor it may be necessary to rehabilitate the system with major investments in new water lines, or the in-place rehabilitation of the existing water mains. New waterlines should be installed under tight inspection standards to reduce leakage at the pipe joints, and stringent pressure tests should be required to confirm that the rate of leakage is within contract standards before the constructed pipes are accepted from the contractor.

7. Water consumed by fires, flushing of drains, etc.: Some reduction may be possible by identifying those uses of water which may use lower quality water. Large and frequent uses may be supplied by a constructed water supply from an acceptable lower quality source, such as a river.

Investments and Revenue Generation

Reports on "privatization efforts" in other cities around the world have noted that Concessionaires are usually able to significantly increase revenues by reducing "non-revenue water" by a number of methods, often without the need for large financial investments. The annual revenue can be increased by controlling "losses" through the first five types of NRW, listed above. The additional revenue can finance, in part, the on-going distribution system improvements necessary to serve more people at a higher level of service, and to control physical leakage of water.

The investment required for the initial NRW reduction program will include the following:

a. Purchase of a supply of new meters, preferably of the type which can be read with a hand-held recording device
b. Labor for installation of the meters, starting with industrial, commercial and other large consumers.
c. Establishment of a meter repair shop and a storage warehouse; hiring and training workers (this can be done while the initial supply of new meters is being installed)
d. Training of meter readers; installing a good "supervision" and loss-control system
e. Installation of a computerized billing/record keeping system, using the inputs from hand-held devices; production of reports to provide management the information on water use and revenue earned.
f. Verification of the accuracy of the 'master meters', which measure the input to the system, and of any meters used to record flow between distribution systems.
g. Illegal connection reduction program - labor intensive; training and supervision required.
h. Initial system survey to identify any obvious and/or large water losses.

The amount of additional revenue to be gained will depend upon the amount of NRW that is attributable to the NRW types 1 through 5. If the *non-revenue water* losses are assumed to be equal to 51%, as estimated by the JWSSP, a reduction in NRW from 51% to 35% would increase the total revenue received by **over 32%!** Based on a current estimated revenue of US$100 million, the increase will be over $32 million, potentially achievable in a short time frame and for little capital investment. It is also noted that the increased revenue **will continue to be generated** each year throughout the concession period.

Revenue Sharing Between Pam Jaya and Concessionaire

If, under the contract, the Concessionaire is compensated on a "per cubic meter" basis, the Concessionaire will gain about 32% in income, as the volume of water sold will be increased by that amount. PAM JAYA will also benefit, proportionately, by the increase in water "sold", as it will also receive a percentage of the revenue for each cubic meter of water sold. The financial incentives for the Concessionaire, therefore, should drive a substantial and effective program to reduce the non-physical NRW.

The additional revenue gained from the reduction in NRW will provide significant capital for reinvestment in improvements and constrain pressure to increase tariffs.

Measurement of Reductions Achieved in Non-Revenue Water

It is proposed by PAM JAYA to establish a "technical target" for the reduction of Non-revenue Water (NRW). As noted above, the financial incentives may be substantial and the Concessionaire should achieve substantial reductions in NRW. However, it will be important to measure the reductions in NRW for reports to PAM JAYA and to demonstrate the benefits of the actions undertaken by the Concessionaire. If the package of NRW reduction programs work well,

and substantial additional revenues are collected, this will provide a powerful incentive for other PDAMs to undertake PSP or PPP contracts to achieve similar results.

It is important to establish a "base level" for each type of NRW, against which future measurements of NRW can be compared. Sufficient and accurate information will be needed on the losses of water and of revenue to establish the "base levels". Obtaining such information may require several months of effort after the management of the system has been turned over to the Concessionaire(s).

Secondly, as noted earlier, the actual loss through leakage (physical loss of water) can be expected to increase as pressure is increased within the system and water is provided on a continuous basis. Therefore, the leakage "base level" may have to be established after each area is brought up to the basic service standard. This may not occur throughout the distribution system for some period of time.

In the initial period it may be necessary to measure "success" in reducing the NRW by comparison of revenue generated with the latest full year of operation under PAM JAYA, prior to turning over operation to the Concessionaire. However, actual reductions in each type of NRW should be recorded and reported to PAM JAYA on a regular basis, which will permit later analysis of the effectiveness of the program.

Technical Issues Paper No. 3
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TECHNICAL TARGETS: CONSIDERATIONS IN ESTABLISHING THEM AND MEASURING PROGRESS TOWARD EACH TARGET

Introduction

The establishment of certain "technical targets" may be necessary or desirable to define some of the required objectives under a Public-Private Partnership (PPP) or a Private Sector Participation (PSP) contract. A "technical target" should be a clearly defined technical objective for service, quality of water or other aspect of the project. It is usually considered to be an objective to be achieved by the "private party" under the contract, although the GOI may have certain responsibilities to meet a technical target or to support the efforts to achieve the technical target.

In addition, there may be certain "technical requirements" concerning the production of water, the treated water quality and the operation of the water supply system. These may include such things as the pH of the treated water to be provided, water consumption within the treatment plants and other criteria. It is probably better not to consider these to be "technical targets" as they are technical operating criteria which should be obtained in the short run as part of the technical rehabilitation and adjustment process.

Possible Technical Targets

Some or all of the following "Technical Targets" may be included within an agreement between the Government of Indonesia, represented by a PDAM or other agency, and a private company or partnership. Each is briefly described in terms of how it relates to social objectives, public health and/or the quality of service to the consumers (water users).

Target 1: Increase the percentage of people served within the urban area.
(Yearly targets to be set for (a) "additional customers" to be connected; and (b) the total area provided with water service within the Concession's service area)

Target 2: Improve the basic level of service, so that all users receive water at a minimum pressure of 0.75 atmospheres (about 7.5 meters) and have a continuously available supply of water.
(No yearly targets, but a future date set for attainment)

Target 3: Improve the "quality of service", by reducing the reasons for complaints and by improving the "response time" when a service problem is reported, or a request for a new connection is made.
(Yearly target based on maximum number of complaints per month)

Target 4: As a future goal, provide "drinking water" (potable water) to all sections of the city; some sections may reach that target before universal coverage is provided.

(No yearly or future target specifically set)

Target 5: Reduce the percentage of "Non-Revenue Water" (physical losses plus non-physical losses), thus increasing revenue and providing more water for service to new customers.
(Yearly targets for NRW, as a total, compared with total of treated water supplied to the system)

Discussion of Each Technical Target

Target 1: Increasing the percentage of people served within the defined service area.

a. Description of the objective: It is a "social objective" of the GOI, reflected in Repelita VI, that there will be a significant increase in the percentage of urban population provided with piped water. Providing hydrants and common taps for use by several families may meet part of the objective.

b. Definition of a "baseline" from which to measure improvements: The present population served should include those with metered connections, those who are connected but do not have meters (and are not registered) and those presently served by hydrants or common taps. Caveat: using the presently "registered" water users will undercount the number who should be included in the "baseline" population served.

c. Measurement of progress toward the target: Measurement of connections is more direct, and accurate, than measurement of population. The selection of "representative areas" in which to conduct a census of inhabitants per connection would provide information on "population per connection", and this can allow comparison of total population served to total urban population.

Each year, or at shorter intervals, the total number of connections per area can be determined by the Concessionaire from the list of registered connections, and the total number of new connections (net of illegal connections identified) can also be determined, from the records of "requests for connections". The progress will be the total number of connections at the end of the period less the total number at the start of

the period. This should correlate with the separately-defined "total number of net new connections" reported for the period. Separately, the number of hydrants and common taps installed, less any discontinued, and the volume of water used at each hydrant and tap should be reported. From that information the "equivalent connections" or "equivalent connected population" can be determined, using data on per capita consumption at hydrants.

The PAM JAYA staff should have routine access to the basic data collection and records systems and be able to confirm the numbers reported.

d. Incentives which may be provided for attainment of objective: If the Concessionaire is compensated on the basis of "rupiah per cubic meter sold" (i.e., delivered, billed and collected), then there will be a clear incentive for the Concessionaire to add new connections and hydrants. The Concessionaire, and PAM JAYA, will be rewarded with increased monthly revenue.

e. Possible difficulties or "disincentives": A major difficulty is the availability of an adequate volume of treated water to be delivered to the new customers. If there are constraints on the quantity, or quality, of raw water resources that will constrain the production of needed treated water to meet the increasing demand.

A disincentive to providing water to household connections is the presently unbalanced (subsidized) tariff, which provides water to all households at a lower rate than commercial and industrial customers. As the latter customers are also larger consumers, the costs to deliver water, per cubic meter sold, is less, and the incentive will be to serve the non-household customers first, particularly during the earlier years of operation. A balanced tariff, with discounts for those with significantly less income, would remove a significant part of the disincentive.

Target 2: Improving the basic level of water service.

a. Description of the objective: The "social objective", and the basic tenet of good utility practice, is to provide an adequate volume of water, at continuing adequate pressures, and at all times to meet demands of the customers. Specifically, the target is to provide a pressure of 0.75 atmospheres (7.5 meters), at the street level, and a continuous supply of water.

b. Definition of a "baseline" from which to measure improvements: The baseline is essentially the present inadequate pressures and frequent

interruptions in service in most of the areas of the city served by a piped system.

c. Measurement of progress toward the target: Measurement of progress may be simply the attainment of adequate pressure and continuous flow, on a district by district basis. Each district will have it or not. Once attained, the adequate level of pressure and flow is expected to continue, except for short periods due to breaks in water lines or construction interruptions. Quarterly or annual reports should be provided by the Concessionaire on the areas covered by adequate service. An area should be considered to have met the target after a minimum of 30 days recorded pressure information shows attainment. The quarterly and annual reports should also note which areas, if any, have returned to "inadequate level of service", the reason and the plan to correct the insufficiency.

d. Incentives which may be provided for attainment of objective: There is an indirect incentive to provide good service, as continuous flow and adequate pressure will increase water use and revenue. Additionally, the provision of good water supply service will increase the public demand for water service, and decrease the use of groundwater as an alternative supply, thus providing for long-term growth in revenue.

A related incentive to the Concessionaire is the reduced contamination of the water supply (improved water quality) when adequate positive pressure in the pipes will prevent intrusion of contaminated groundwater.

e. Possible difficulties or "disincentives": In the initial years of operation the increase in pressure, and the longer period of time when water is under pressure in the pipelines, may significantly increase leakage (physical losses), and put a strain on the available supply of treated water. This will gradually be overcome as the distribution system is rehabilitated, and the construction of pipelines is closely supervised to reduce leakage at pipe joints.

Target 3: Improve the responsiveness to customer requests and complaints.

a. Description of the objective: The "social objective" is to continuously improve the level of customer satisfaction with the service provided to them. The customer satisfaction can be measured by the number of complaints made to the Concessionaires, and the time required and adequacy of resolution of the problems identified. Additionally, responsiveness in providing new connections in a timely manner is to be continuously improved.

b. Definition of a "baseline" from which to measure improvements: The baseline is the present level of responsiveness. The measure of the number

of complaints received is adjusted by counting all complaints about the same cause, such as lack of water due to a water line break, as a single "complaint" for tracking purposes.

c. Measurement of progress toward the target: Each Concessionaire should establish procedures for receiving, recording and acting upon each complaint. It will also be necessary to record the action taken and the time to resolve the problem. For requests for new connections, the Concessionaires should have a clearly defined system to record the request, obtain the necessary permits, notify the customer about the payment for the connection, and complete the connection. Measurement of elapsed time should be measured from the time when the customer's payment for the connection has been received, which will be after the receipt of all required permits by the Concessionaire. Reports to PAM JAYA should contain the number of complaints, the type of problem, the time for resolution and comparison with prior reporting periods. For new connections, the time required to obtain permits and payment from the customer, and the time to make each connection should be reported. Improvements in performance for the permitting process, or any increases in time, and improvements in the time required for connections to be made should be reported in comparison with prior reporting periods.

d. Incentives which may be provided for attainment of objective: The incentives for the Concessionaires are related to good business practice of improving relations with customers, and potential customers, and thus increasing the sale of water by encouraging new customers to connect to the water system.

e. Possible difficulties or "disincentives": There is a possible difficulty in accurately measuring "customer satisfaction" by measuring complaint frequency, as there may be increasingly higher expectations for good service and rapid response to complaints as each Concessionaire establishes more of a reputation for improving service. Customers may also raise their expectations of what level of pressure and quality of water should be provided as they experience some improvements. This difficulty can be offset, in part, by gathering and reporting further information on the type and frequency of complaints.

Target 4: Provide potable water ("drinking water" quality) to all areas of Jakarta.

a. Description of the objective: The objective is to improve the bacteriological quality, and other quality parameters, to the World Health Organization's definition of "potable water", although the time frame for doing so is indefinite.

b. Definition of a "baseline" from which to measure improvements: The present water quality varies, from area to area and from time to time; the present quality does not meet the objective in any areas at the present time.

c. Measurement of progress toward the target: The water quality should be monitoring on a frequent basis as it enters into the distribution system. In addition, scheduled water quality tests should be made at a number of points throughout the system for bacteriological quality. The results can be statistically evaluated over each month and a determination made of the water quality level. When certain areas have been provided with higher quality water, those areas can be evaluated separately and results reported on an area by area basis.

d. Incentives which may be provided for attainment of objective: The improvement in water quality to "potable" standards may warrant an increase in the tariff for that water within areas where it is available, as it is a more valuable product. Thus, the increased revenue will flow to both the Concessionaires and to PAM JAYA.

e. Possible difficulties or "disincentives": In order to achieve the objective a significant investment will be required to improve the distribution system and to ensure the reliable supply of water under pressure. The costs are possibly greater than the additional revenue to be gained by producing a "better product".

Target 5: Reduce the amount of "non-revenue water", including both physical and non-physical losses.

a. Description of the objective: The objective is to increase revenue substantially to pay for the system improvements necessary to expand service areas and improve the quality of service. A second objective is to correct physical leakage and so make additional treated water available for sale to new customers and for continuity of water supply to existing customers.

b. Definition of a "baseline" from which to measure improvements: As the "non-revenue water" is composed of seven (7) components, six (6) of which are included within the common definition of "unaccounted-for water" (UFW), the improvements in each component must be measured against its individual baseline.

For water used but not accurately recorded on installed meters, and billed, the baseline will be the existing volume recorded on the records.

For water used but not recorded on meters and water metered but not billed (e.g.,municipal, military use), the baseline is essentially zero revenue.

For water consumed by public functions, such as fires and main flushing, the present estimated use is the baseline.

For water lost through physical leakage, the baseline must be determined by isolating individual areas, measuring flow in and water metered, and calculating the amount lost after subtracting what may be beneficially used due to under-recording or illegal connections.

c. Measurement of progress toward the target: Measurement of change must be based upon metering of water into the distribution system (the "master meters") and the water consumed at each connection.

d. Incentives which may be provided for attainment of objective: The major incentive is the increase in revenue, which will be obtained by accurately measuring all water consumed, billing for the full amount consumed and collecting all revenue due.

e. Possible difficulties or "disincentives": There are a number of difficulties in measuring the actual physical loss of water, then finding the large number of leaks so that repairs may be carried out. The disincentive is that the cost of finding and fixing many of the small leaks may be greater than the revenue gained, so there is a decided curve of "diminishing returns" which will prevent reduction of physical losses below a certain level. The difficulties in correcting the non-physical losses include the need to change an existing system of rewards and adequately training and providing of incentives for the field crews to correct illegal connections and underbilling problems.

Makalah Mengenai Masalah-Masalah Teknis No.4
Laporan PURSE No.7.3.A\96\040-TIP4
Penulis: Lindley H. Hall, Penasehat Pelayanan Perkotaan, Proyek PURSE

PENJUALAN AIR BAKU ATAU AIR DALAM JUMLAH BESAR *(BULK WATER)* ANTAR PERUSAHAAN, BAIK PEMERINTAH MAUPUN SWASTA

Pendahuluan

Laporan ini menyajikan masalah-masalah yang perlu dipertimbangkan dalam menetapkan dasar pembayaran untuk pembelian dan penjualan air dalam jumlah besar. Tujuannya bukan untuk menyajikan rincian dan bahasa kontrak tertentu yang paling sesuai digunakan bagi suatu proyek. Namun, laporan ini akan memberikan saran kepada pimpinan PDAM, staf-staf lain dari Pemerintah Pusat, dan pihak-pihak swasta yang berminat terhadap suatu usulan kontrak akan masalah-masalah atau faktor-faktor yang mungkin memerlukan perhatian khusus.

Evaluasi awal dari suatu proyek yang disebut "Studi Pendahuluan Kelayakan" , harus dilakukan oleh PDAM dan meliputi pertimbangan terhadap faktor-faktor ini. Bilamana Pihak Swasta di kemudian hari melakukan "Studi Kelayakan" terhadap suatu proyek tertentu, Pihak Swasta tersebut harus membahas faktor-faktor ini maupun pertimbangan lain yang relevan menurut Pihak Swasta tersebut. Kepentingan Pihak Swasta meliputi juga kepentingan para calon investor dan lembaga pemberi pinjaman misalnya bank.

Definisi Istilah

Definisi berikut dipakai dalam Laporan ini; disarankan agar dalam diskusi dan dokumen istilah-istilah yang dapat mempunyai arti yang serupa namun agak berbeda dibedakan secara hati-hati.

1. **Tarif (atau "daftar tarif")**:
   Daftar harga "eceran" yang ditetapkan untuk air bersih yang dijual kepada "pelanggan" sistem penyediaan air bersih. Tarif tersebut ditetapkan sesuai dengan peraturan Departemen Dalam Negeri yang berlaku, dan biasanya meliputi tarif yang berlainan untuk kelas-kelas konsumen yang berbeda.

2. **Harga jual air bersih dalam jumlah besar** (atau bulk water price atau "harga air bersih dalam jumlah besar"):
   Harga (biasanya berdasarkan volume) yang ditetapkan untuk penjualan suatu unit air bersih untuk pendistribusian lebih lanjut kepada pelanggan. Harga tersebut bisa dianggap sebagai harga "grosir". Air dapat dibeli oleh PDAM atau Pihak Swasta lainnya dan harga yang ditetapkan memang dapat beragam menurut kuantitas yang dikirim, atau menurut parameter lain seperti kualitas dan keandalan pasokan.

3. **Raw water sale price (or "raw water cost"):**
The price established for untreated ("raw") water delivered to a specific point and based upon the volume delivered. In some cases it may be a monthly cost for a specified total volume, in which case the price may be computed on a unit basis from the contract paramenters.

4. **System interconnection point:**
A location where a water main (pipe) crosses the defined "boundary line" between two water distribution systems or concessions. The interconnection point will usually be the point where a flow measurement device is installed: a valve is usually installed in line with the flow measurement device to permit the cut-off of water flow across the boundary line.

Note: The system interconnection point may sometimes be an "emergency interconnection", opened only when an emergency demand for water (e.g..major fire or major waterline break) must be met by flow through the interconnection point. Emergency connections are not considered further in this paper as the water flow is usually infrequent and of short duration.

5. **Service reservoir (receiving reservoir):**
A water reservoir, usually for treated water, which may be a discharge point for treated water pumped from a water treatment plant. Service reservoirs then deliver water to the distribution system, as required by the demand for water.

Raw Water Sales

Factors in the Contract

A municipal water supply system (PDAM or Concession) may acquire a source of raw water for one or more of its water treatment plants by contracting with a public organization, such as POJ in West Java, or a private company to supply the required volume. The contract should specify how much water is to be provided, whether the flow is to be continuous at the given rate, the requirements for the acceptable quality and the location and pressure at which the water is to be delivered.

In most cases the "supplier" will develop a reservoir, a water intake, a supply pipeline and needed pumping stations to collect, store and deliver the supply of raw water under the contract. The "purchaser" (municipal water supply system) would enter into a long-term contract to purchase the water and to pay an agreed-upon fee, usually a set amount per cubic meter of volume. In some cases raw water may be delivered via a natural river or canal to the location of the treatment plant operated by the municipal water supply system.

The contract would logically be for a period of many years, with the option to extend it, and would contain a mechanism to cover increased costs through increases in the *raw water sale price* paid by the buyer.

Each of the two contracting parties must be able to rely on the good faith and performance of the other, and there may be more than one purchaser of the raw water supply. Therefore, a governing body may be established on which the "supplier" and the "purchasers" are represented. Representatives of Government agencies involved in water resources management may also be on the governing body. Such a governing body can address the long-term water resource management issues, including the control of raw water quality within the drainage basin.

Measurement of Water Delivered

Raw water may be delivered by pipeline, canal, covered canal or diversion into an existing stream. When water is diverted into an existing stream the volume added to the stream flow would be approximately equal to that removed at the downstream water intake structure, from where the raw water would be conveyed to the Water Treatment Plant.

The basis for payment should be the volume of water delivered for use at the Water Treatment Plant. The contract may allow for a varying amount to be consumed, as demand for treated water fluctuates, or it may be based on a steady supply of water and a total guaranteed daily volume. In each case the volume delivered to the Water Treatment Plant should be the basis for payments.

The method of measurement will depend upon the design of the delivery system. When the water is pumped the volume moved through the pumping station will be the most reliable measurement. This may be the rated pump output, in volume per minute, times the recorded operating time of the pump. However, if the pumped water is exposed to loss through canal leakage, evaporation or other causes, then the point of measurement should be the point of intake at the Water Treatment Plant. A weir or other measuring device should be installed in a location where a recording device can be operated and maintained, and easy access can be provided. Security for the equipment should be provided, and a location within the perimeter fence of the Water Treatment Plant would be desirable.

When water is delivered via an open or a covered canal the measurement point should be at the intake at the Water Treatment Plant.

The measurement device should be calibrated before initially used, and usually on an annual or more frequent basis during the years of operation. A second method to confirm the accuracy of flow measurement, such as the time required to fill an empty reservoir, is worthwhile to ensure proper installation and operation of the measurement device.

Both the seller and the purchaser should have representatives present during the calibration tests.

Determination of the Initial Sales Price

The contract between the "Seller" and the "Purchaser" will specify the *raw water sale price* per cubic meter, or other specific sales price to be charged for the water consumed. In developing the initial sales price the "Seller" of the water must calculate the capital costs of the water supply reservoir, pumping stations, canals, pipelines and other works, and the cost of any loans (interest) which are necessary to help pay for the construction. In addition, the management and operation costs, which will be incurred annually, must be closely estimated. All such estimated costs can be easily established when the final design has been completed; alternatively, actual construction costs may be used as the basis for the established price of raw water. Based upon the estimated or actual costs a single price per cubic meter can be calculated.

A "contingency amount" can be included in the *raw water sale price* to cover such items as increases in power costs which are expected to occur during the period of time the sale price will be in effect.

In some contracts the "purchaser" will be buying only part of the water collected, transported and delivered to several purchasers. Therefore, the construction, financing, management and operation costs will have to be allocated among two or more Purchasers. For those water supply works used by two or more Purchasers the related costs should be allocated to each Purchaser on the basis of the percentage of total water delivered to each of the Purchasers. Then, for each individual Purchaser, the related costs for delivery facilities serving only that Purchaser should be added onto the shared costs to develop a total *raw water sale price* for that Purchaser.

During the calculation of the "initial" *raw water sale price* all of the components of cost will be identified and values placed on each. This information will form the basis for any future adjustment in the "sale price" when one or more components change over a period of time.

Adjustments in the Raw Water Sale Price

During the development of the contract between the "Seller" and the "Purchaser" detailed consideration must be given to when and how the initial *raw water sale price* will be adjusted. If the Purchaser pays for the raw water on the basis of the volume delivered, it is logical to have an initial price in Rupiah per cubic meter, and that is the price that would be adjusted when costs increase - or, possibly, when certain costs decrease. Adjustments would only need to be made after a period of time, say 5 years, unless specified costs increased more than an established percentage (e.g., more than 20% during the 5 years).

For adjustment of the *raw water sale price* certain components of capital and operating costs should be considered. Capital costs for completed structures and facilities would not increase over time, although the financing costs (mainly interest costs) might be adjusted periodically. The initial financing costs will be determined at the time of construction; changes, either upwards or downwards, in the annual interest and related costs can be determined and the

percentage change calculated easily. That percentage change can then be applied to the "percentage" that the financing costs represent within the total initial *raw water sale price*.

Similarly, the costs of labor, overhead, energy (electricity, etc.), materials and other consumables would be evaluated, and each factor would be increased or decreased by the percentage. Each factor would be adjusted separately, then the list of cost facctors summed to determine the "adjusted" *raw water sale price*.

Alternative Method of Purchasing Raw Water

As an alternative, it is possible to base the contract upon a certain percentage of the actual costs incurred by the "Seller" of the raw water (i.e., a lump sum payment for providing a contract volume of water). This would be a valid approach when two or more Purchasers join together with the Seller in a long-term arrangement to build, operate and maintain facilities which might be financed by the Seller or loans to the Seller. In this alternative method of purchasing water the contract would simply specify the costs to be included in the total annual amount to be divided among the Purchasers, in accordance with each contract.

Each Purchaser could calculate his "raw water cost" by dividing the annual cost paid to the Seller by the total volume of water delivered, thus defining the "raw water cost" in Rupiah per cubic meter. This might be a necessary calculation when the Purchaser sells treated water at a cost which is adjusted when changes occur in the "raw water cost".

Special Considerations

The alternative method of using the official Indonesian "cost of living" index may be useful for evaluating changes in estimated costs over time in the Feasibility Study, but the components in the index do not accurately reflect the specific commodities and labor used on a water supply project. For instance, food and housing represent a significant part of the cost of living, but are not components in a water project. On the other hand, energy for pumping water may be a major component when gravity flow is not possible, and small changes in energy costs may significantly influence operation and maintenance costs for a project.

A second consideration, on some projects, will be the changes in costs due to significant changes in the raw water delivery system. If pumping stations are replaced with a gravity flow canal the capital costs will increase, while the annual operational costs will decrease.
A change in the *raw water sale price* may be necessary to reflect the changes in both the capital and operating costs.

A change in the raw water delivery system may be due to the addition of a new purchaser of raw water. The contract between the two parties should allow for such a contingency, and the reallocation of costs among the several "purchasers" when that method of payment calculation in used. However, the original "purchasers" should not be expected to pay part of the costs for supplying the additional water required by the new purchaser.

Bulk Water Sales

Factors in the Contract

A "bulk water project" would include treatment of the raw water, and delivery of the treated water to the municipal water supply system, under a long-term contract. The constructed facilities often include a water intake on a river or lake, a pumping station and transmission line to a treatment facility, the treatment facility, and a reservoir into which treated water is discharged. However, certain projects may include only some of these facilities, or the project may include additional facilities. It is necessary to clearly define the physical bounds of the project for both construction and its operation. The Operator of the bulk water project facilities should be able to plan and execute all aspects of operation and maintenance without undue or unexpected constraints imposed by the "purchaser" of the bulk water supply.

The contracting parties may be either public or private companies. In some cases, either one may be the "seller" and the other the "purchaser", depending upon the net flow of treated water through system interconnections in the period of time. This sale of treated water across a system boundary is discussed in *Technical Issues Paper No. 5*.

When bulk water is to be provided to the Municipal Water System under a long-term contract, it would be advantageous for the Municipal Water System, such as a PDAM, to complete a "Pre-Feasibility Study" to clearly define the project, the basic terms of a proposed contract and the objectives of such a bulk water supply contract. Based upon that study, it could then develop a "request for proposals" and solicit proposals from several companies to build, finance and operate a bulk water supply project. The eventual transfer of the project to the Municipal Water System can be a requirement of the proposed contract.

If a competitive bid approach is used, each of the contractors can be requested to provide a lowest price, per cubic meter, at which the company would provide treated water meeting the requirements set by the Municipal Water System. The contract can then be based upon the quoted price in the proposal, although consideration must be made within the contract for changing conditions, including rising costs of labor, materials and energy.

Measurement of the Water Delivered

Treated water will almost always be delivered by a pipeline to a receiving reservoir, from which the "purchaser" will distribute the water or transfer it to another location for distribution. The flow may be by gravity, or the water may have to be pumped if the reservoir is not located at a lower elevation than the water treatment plant.

The logical point of measurement is at the point of discharge into the receiving reservoir. A flow measurement device may be placed within the pipeline, or in a channel close to the discharge point. The measurment device, and the flow recording equipment must be well protected from damage.

If the water is pumped the measurement may be based on the rated pump output and the operating time of the pumps. However, this is based upon the "point of sale" being at the pumping station. Any water losses through leakage in the pipeline to the reservoir would be the responsibility of the purchaser.

A regular check on the measurement device should be conducted; one method would be to use the known volume of the receiving reservoir as a comparison with the recorded volume pumped or discharged. The difference in the volume measured may be due, in part, to leakage along the pipeline if the water volume pumped is calculated to be higher than the volume discharged into the reservoir. Both the "seller" and the "purchaser" should be present at the periodical checks on the measurement device accuracy.

Determination of the Initial Bulk Water Sale Price

As described earlier for the purchase of "raw water", the capital costs and the operating costs must be closely estimated to determine the price, in Rupiah, per cubic meter at which the treated water will be sold. The operating costs for the treatment processes may vary with the quality of the raw water, and the costs of chemicals, power, labor and other components may increase over time. It is reasonable to estimate the expected increases for each component of the operation and maintenance costs, in terms of the units of measurement used for each, and to include such expected increases within the stated price per cubic meter.

Adjustments in the *bulk water sale price* due to unexpectedly large changes in operating and maintenance costs can be based upon the factors discussed in the following section.

If bulk treated water is delivered to two or more "purchasers" the *bulk water sale price* for each may be the same, or it may be higher for one due to additional defined costs, such as pumping of the treated water to a higher level reservoir.

The initial *bulk water sale price* may also be based upon a minimum level of raw water quality, below which (e.g., higher levels of turbidity) the adjustment factor for raw water quality is applied as a surcharge, as specified in the contract.

Adjustments in the Sales Price

Adjustments in the *bulk water sale price* per cubic meter should be permitted by the contract. The adjustments should be based upon measurable factors, such as the price per unit volume of each chemical consumed. The adjustments should not be based upon the total amount of chemicals used or labor employed, as such measurements do not encourage the greatest efficiency of the operation. It is noted that the costs of chemicals, power, labor, materials and other cost components can be obtained in the marketplace, and also by contact with other treatment plants operating in the region.

After the adjustment in unit price is made for each component, the percentage of that component within the total *bulk water sale price* shall be adjusted, in rupiah. Each component shall have a "percentage" for that cost component identified at the time of the initial contract, and the percentages should remain fixed over the life of the contract, taking into account the total percentage for operation and maintenance costs in comparison with the capital and interest component.

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ISSUES CONCERNING TRANSFER OF TREATED WATER BETWEEN TWO OR MORE PRIVATE PARTIES AND/OR PDAMS

Introduction

A municipal water supply system is often physically separate from other water supply systems. However, in larger metropolitan areas two or more systems may have each been expanded until they are contiguous to each other. In some areas the available water supplies must be shared by two or more water supply systems. In both cases it is usually desirable, and often necessary, to interconnect the systems to allow for movement of treated water from one distribution system into another.

There are several management and operational considerations when such interconnections are constructed. Firstly, there are issues about measurement and payment for water which is transferred; secondly, there may be concerns about the long-term financial viability of the contracting parties and the continuing ability to perform under the contract terms.

In this "Technical Issues Paper" we present the issues and discuss the factors which should be considered in developing a contract for interconnection of water systems, and the management and operation of the interconnections.

Reasons For System Interconnections

It is in the interest of any water distribution system operator, a PDAM or a Private Operator, to have "system interconnection points" with adjoining water supply systems to allow the transfer of water from one system to another. In many cases these interconnection points will be for emergency use when the supply of water to one of the two systems in interrupted for any reason, a major break results in large water flows or some event, such as a major fire, puts a large demand on one system's available supply.

In many other cases it is worthwhile for two systems to share a source of water, such as a treatment plant located on a large river. The transmission of water can be easily accomplished through one water distribution system to the *receiving* system, assuming that the *transporting* water distribution system has adequately-sized water mains. It is noted that water flows by many routes through a distribution system, only congregating at those system interconnection points which are open for transfer of water.

A third type of transfer of water is taking place in the existing PAM JAYA distribution system across the "boundary" recently established to define the two separate "concession areas". Because the system was designed and constructed as a single system it will be necessary to make some physical changes to reduce the number of "interconnection points", and to install measuring devices which can record flow in either direction. These physical changes will permit a physical boundary to be established, as would be the case if the two systems had developed independently, then had established interconnection points for their mutual benefit.

Factors to Consider in Construction and Operation

The location and number of the interconnection points should be determined by a hydraulic analysis of the flow of water which will occur during (a) normal flow conditions; and (b) high flow conditions, such as emergency transfer of water from one system to another. It is preferable that the two systems interconnect their larger primary distribution mains, and that the interconnection pipe be sized, itself, to handle the flow with minimal frictional losses.

Each interconnection line should contain (a) an isolation valve; and (b) a flow measurement device. When flow may occur in either direction the measurement device should be capable of measuring the reverse flows, when they occur. Consideration should also be given to controlling the valve from the System Operations Center and to remotely monitoring the rate of flow occurring.

When the quality of water may vary in either system, the interconnection point should be equipped with sampling ports so that operations staff can take water samples to check on the quality of the water flowing between the systems. (NOTE: A "sampling port" is a small pipe installed into the water main and equipped with a small valve. By opening the small valve a sample of water can be quickly extracted for analysis.)

Factors to Consider in Management of the Interconnection

The system interconnections must be constructed and operated in accordance with a mutually-satisfactory contract between the two system owners. It should be clearly decided who has the authority to make decisions on (1) opening and closing the valve; (2) the volume of water and the rate at which it may be transferred; and (3) the method of reporting water flows and calculating payments to be made under the contract.

Part of the agreement on management of the interconnections should address "emergency conditions" which may be experienced within one of the cooperating water supply systems. "Emergency conditions" may include a major water line break, a large fire with large water demands for extinguishing it, a partial or complete shut-down of a treatment facility or extensive damage caused by earthquake, floods, or other natural disaster. It may be necessary for both systems to share limited water during emergency conditions, and the use of interconnections to transfer water may need to be coordinated with water demand constraints throughout both systems.

The flow measurement devices must be kept in good repair and periodic checks made on their continued accuracy of measurement. The flow recording devices should be checked and the flows recorded on a regular basis, although these functions may be controlled remotely. Both management teams should have access to the flow measurement device and the records of operation.

The payment for the water transferred from one system to another should be based upon the volume recorded. Adjustments in the price per cubic meter may be used to compensate for any shortfall in specified water quality, or for other factors agreed upon between the two water supply system managers.

Contractural Protection for the Consuming System

Emergency Use of Interconnections: When the interconnections are used only occasionally during emergency conditions each of the water system managements must be assured of the availability of water when an emergency does occur. The contract between the two systems should address any issues relating to such emergency reliability, including the periodic opening of the isolation valve to allow flow of water through the interconnection pipeline to be sure it actually will perform, when needed.

Regular Use of Interconnections: Interconnections are often used on a routine basis, and either or both water systems must be assured of a continuing water supply via the interconnection. Specific clauses within the contract should address all issues which might affect the continuity of the supply. These issues include:

a. adequate volume of water to meet anticipated demands for water transfer;
b. adequate quality of water made available on a regular basis;
c. water delivered at the pressure required to sustain the required flow and/or deliver the water to a receiving reservoir within the receiving water system.

These requirements may not be met if the supplying system is poorly managed or operated, or if it is in financial difficulty and not able to continue to operate as expected.
Poor management or financial difficulties are often indicated by inadequate facility operation and maintenance. When this is noticed then action should be taken to provide expert assistance in management and operation of the system. An alternative action would be to contract operational management and maintenance to a Private Company, or to a stronger PDAM who is able to take on the responsibility. If such an action is taken the contract between interconnected water systems would continue to be valid and to govern the delivery of water to the adjoining water system.

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THE PURSE PROJECT

In December 1991 the U.S. and Indonesian governments signed an agreement to encourage private investment in the provision of public water supply, wastewater treatment and solid waste management services in urban areas throughout the archipelago. In recognizing that its capacity to finance the needed projects is severly strained, and that insufficient urban infrastructure will adversely affect public health and welfare and inhibit future economic growth, the Government has been looking increasingly to the private sector to participate in the provision of these essential services.

PURSE is working with USAID/Indonesia's Office of Private Enterprise Development and several agencies of the Government of Indonesia through a combination of technical assistance and capacity building interventions to:

- develop policy consensus and a legal framework that clarifies current rules and formulates new or revised regulations pertaining to private investment in all aspects of municipal infrastructure development and/or provision of urban services,
- demonstrate the technical and contractual feasibility of various forms of Public-Private Partnerships through demonstration projects, and
- transfer knowledge and expertise to public sector officials in relevant technical, financial and managerial aspects of environmental infrastructure.

For more information on the PURSE Project, please contact Chemonics International or the PURSE Project at the addresses listed above.