

WaQuAC-NET Newsletter vol.26

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1. Technical Q&A



Question & Answer Corner

We welcome any opinions, and questions to this Q & A Corner. Please contact us.

Q: NRW ratio is 50% around in our water supply. I want to know a method of NRW reduction.
(S.K., Bangladesh)

A: Countermeasures to reduce non revenue water

Answerer: Mr. Kenji Nakanosono



Mr. Shinta Segawa

(Yokohama Water Co. Ltd.).

1) At first, top management of water supply utility should recognize that their utility has high non revenue water and the fact that such high non revenue water (NRW) may cause lack of water resources, lack of energy and worth management.

A department director of the counterpart organization, which I had been dispatched before, said "Our utility has no water leakage upon the ground nor leakage under the ground". Another department director did not accept the fact even

though the JICA expert team showed leakage points on a map with photographs of the sites. We showed how much water was leaked with movies. Finally, they understood that they wasted water resources, money and energy and how important reducing non revenue water is.

2) After the utility started reducing non revenue water, grasping contents of non revenue water is necessary. According to "Standard IWA/AWWA methodology of balancing consumption and water losses" shown in Fig 1. The utility should find which part is wasting more water.

Baseline condition should be surveyed in a districted metered area (DMA) which is planned before the surveillance. Minimum night flow is measured from 2am to 4am when water is slightly used. The

System Input Volume	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption (readings of the consumer water meters)	Revenue Water
			Billed Un-metered Consumption (Estimates of Consumption)	
		Unbilled Authorized Consumption	Unbilled Metered Consumption	Non Revenue Water(NRW)
			Unbilled Un-metered Consumption	
	Water Losses	Apparent Losses	Unauthorized consumption	
			Customer Metered Inaccuracies and Data Handling Errors	
		Real Losses	Leakage in Transmission and Distribution Mains	
			Storage Leaks and Overflows from Water Storage Tanks	
			Service Connections Leaks up to the Water meter	

Figure-1. Standard IWA/AWWA methodology of balancing consumption and water losses

measured flow is a part of water losses. With the measured amount, water supply utility makes a plan how to reduce water losses and proceeds it. Amount of water which is used in distribution network or treatment plant (unbilled un-metered consumption), insensitive water to meter, illegal connected water (stolen water or unauthorized water), leakage upon the ground and leakage under the ground, etc. should be also surveyed.

For accuracy of water meter, acceptable error is decided as $\pm 2\%$ by the law in Japan. Such criteria should be set because there is no such law or regulation in many developing countries.

For illegal connection, staff should have enough communication with illegal users to explain the meaning of surveillance while meter reading or surveillance of water losses. In my experience, a staff member of water supply was arrested by the police while he explained to the user about illegal connection that he found. I heard that high-ranking officials and rich families make illegal connection more than ordinary people in that country.

In Japan, service pipe between distribution pipe and water is managed by water supply utility. On the other hand, a customer repairs the leakage from service pipe in some developing country. In such country, ownership of piping is not decided or staff of

water supply does not know the regulation even there is the regulation on ownership.

3) Human resources development will be more important.

Training on maintenance of distribution network is necessary. Training for meter readers is also necessary to obtain accurate data and inhibit illegal actions. Display of water meter has also a problem. There are some kinds of meters as showing till $1m^3$, 100L, 10L etc. I have ever seen three kinds of meters were set in one DMA. Same type of meter should be set in a supplying area. However, it is decided under each country's condition and not easy to improve.

4) Leakage should be surveyed in time when water is supplied.

There are few countries where leakage is surveyed according to the surveillance plan. For example, a water supply utility surveys leakage from 10am. And no leakage is found because the utility supply water from 5am to 7am, for just 2hours. Then, road is already dried at 10am. The utility can say that there is no leakage upon the ground.

There are many utilities which have no leakage detector or which have no staff to handle the detector properly even they have it. I found some cases that leakage detector was not used: the

machine was covered with dust because it had been not used; the machine did not work because cables were broken; staff member could not exchange batteries or battery was not sold in that area.

5) Appropriate equipment and maintenance for it is important.

Polyvinylchloride (PVC) pipe and asbestos cement pipe are popularly used in developing countries. There are many leaking points from joint with these kinds of pipes. Leakage will happen in several years after it is repaired because of less skill of repairing. Many leakage detectors have been provided from Japan to Indonesia. Staff of Indonesian waterworks authority often ask Japanese expert why they cannot find a leakage with the equipment. Provided detectors are matched to finding leakage from iron pipe and staff cannot find the leaking sound from PVC pipe. They need an equipment designed for leakage from PVC pipe. Recently, such equipment, which can show analog and digital result, is developed. With proper equipment and effective plan, leakage should be surveyed.

6) There many utilities which have no pipeline map. Mapping of network is important to reduce water losses.

Location, diameter, material and laid year of distribution pipe are very important information to make plan of reducing water losses.

7) Effective countermeasures against water loss are replacing old pipe and appropriate choice of its diameter and material.

Using old distribution pipe and service pipe does not contribute to reduce non revenue water. Repairing such pipe is no solution because other leakage may happen soon. Though replacing pipe costs more than repairing, using long life material for new pipe decreases possibility of leakage and reduces total cost. And material with less joint and protecting corrosiveness contribute reducing water losses too. Reducing water losses realize stable supply of safe water. It provides customers enough satisfaction and attracts new customers.

8) Life Cycle Cost (LCC) for 100 years should be considered.

LCC for long years is calculated with various kind of material, equipment for network and service pipe. With the result, the best material is chosen for distribution and service pipe. Then LCC can be lower even if the initial cost is higher than usual.

9) Summary: necessary countermeasure against non revenue water.

- ✚ Understanding the present condition of NRW and establishing NRW reduction section
- ✚ Managing distribution network map
- ✚ Surveillance in each DMA
- ✚ Managing and exchanging water meter
- ✚ Human resources development for staff and construction workers
- ✚ Usual management of equipment
- ✚ Replacing old pipe
- ✚ Considering LCC

Introduction of New Members

○ Mr. Masaru Matsuoka (Japan)

◎ We welcome new members anytime◎
Please contact us

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Next Activity

Oct., 2015 Ms. SITI from Indonesia),
Welcome Party

Oct., 2015 Presentation by Ms. Siviliai
(MWA, Thailand) at JWWA
Conference

Nov., 2015 Newsletter vol. 27 (JPN)

Dec., 2015 Newsletter vol. 27 (ENG)

2. Voice of Foreign Member

Interview

Dr. Chea Visoth

**Deputy Director General.
PPWSA**



I made an interview with Dr. Chea Visoth, Deputy Director General, Phnom Penh Water Supply Authority of Cambodia on behalf of the foreign members of WaQuAC-NET. Dr. Visoth has often communicated with us by e-mail and visiting each other since WaQuAC-NET began.

(Interviewed by Ms. Mina Yariuchi, WaQuAC-NET)

Q: Voices of foreign members are very precious for us. Can we have your opinions on what you expect to us and future activities?

A: I suppose there are many foreign members expecting activities of WaQuAC-NET. However, few members dare to present their questions to WaQuAC-NET Office. We, Asian people, are tend to hold back to make a request to unfamiliar person. Some members may be too shy to communicate in English. I recommend you, WaQuAC-NET Office, to consider how to activate and get involvement of the foreign members.

For example, you should remind the foreign members that membership fee is free of charge for a foreign member, who are welcomed to share questions and comments anytime. You can also send concrete questions such as "what are recent problems of your utility?" in occasion of issuing a newsletter. These actions can awake the foreign members who have been interested in WaQuAC-NET. As seen in the some newsletters, requesting some reports of their own utilities are also good idea. If you contact not "CC to all members" but individually, I suppose many members welcome to write articles. Finally, the questions raised from the members can get to be

shared with and answered by the foreign members. This is the final stage that WaQuAC-NET aims, isn't it? Although some foreign members are relatively passive, they like only to read newsletters and the website, it is important for you to find and keep in touch with active members. I think advantage of WaQuAC-NET is to enable to communicate among the members mutually, not one-way information providing. I do expect the foreign members to participate more actively.

3. Activity in Japan

[Report]

Seventh Kyushu Branch General Meeting

Mr. Katsutoshi Kagata

The yearly Kyushu Branch General Meeting of WaQuAC-NET was held in Fukuoka city on the 1st of August. Participants were Mr. Nakashima, the leader of Kyushu Branch, Mr. Oda, Mr. Akaishi and I from Kyushu Branch, Ms. Yamamoto from Tokyo the representative of WaQuAC-NET and Mr. Matsuoka from Fukuoka City Waterworks Bureau as a guest, in total 6 persons.



After the introducing themselves, Ms. Yamamoto reported the activity of last year and explained the activity plan of this year including the activity already performed. And then each participant reported their activities.

At first Mr. Matsuoka who was dispatched to YCDC (Yangon City Development Committee Water Health and Medical Bureau) for 3 years as a JICA expert, and came back, reported the situation of water supply of Yangon City. His report extended to several points such as the current condition and the problem of YCDC, his activity, suggestions and recommendations. He explained in detail with Power Point in particular about the cause of non-revenue

water rate that is extremely higher than other Southeast Asian countries. The detail of his activity is featured in newsletter No. 26.

Mr. Oda reported about the activity of the grass-root project that Fukuoka City Waterworks Bureau carried out from 2014 in Fiji. He said "The young staff in Fukuoka City experienced studying and guiding the repair work of pipe leaking which they cannot experience in Fukuoka and this kind of activity is very effective in capacity building for not only the staff of Fiji but also the young staff of Fukuoka." I had an impression that the trustable relationship and the result made by Mr. Oda during his senior volunteer years led them to perform aggressive activity. Following these 2 reports, I reported from the viewpoint of capacity building about the grass-root project in Siem Reap, Cambodia that Kitakyushu Waterworks Bureau carried out. Mr. Akaishi reported about the Cambodian farm village water supply project.

Mr. Nakashima reported about preparation for new business in China. This general meeting gave us the expectation that the international technical cooperation of Fukuoka City Waterworks Bureau will greatly develop from now on. We had to stop the active discussion because of insufficient time last year, and I was sorry that we could hardly take a time for discussion this year too. Reflected on this year to make a more fruitful general meeting next year and closed the meeting.



From left; Mr. Oda, Mr. Kagata, Ms. Yamamoto

Mr. Matsuoka, Mr. Nakashima, Mr. Akaishi



Introduction of New Member

*Dreaming of an African version of
WaQuAC-Net*

Shinich Sekimoto

(Kyowa Consultants)



I had worked for research and development on countermeasure against leakages and older pipeline in Japan. I decided to be a Japan Overseas Corporation Volunteer, and I've stayed at Kenya for two and half years. Using my work in Japan, I could produce the project for management of non-revenue water in Kenya although I went there as a volunteer for water quality inspection.

At first, I was surprised at concept of non-revenue water because it wasn't focused in Japan. Kenyan staffs went into action at their own initiative, so I worked for the project together as one of the staff. Moreover, I received invitation from many water supply utilities and went around Kenya. From such an experience, I realized not only the importance of leading and spreading management of non-revenue

water but also the capability of the project expansion in Africa. My office received country commendation from Kenyan government and was adopted as receiving office of the third country training by JICA. I'm proud that counterparts who worked with me together keep acting with confidence. Waterworks in Kenya are in the midst of reformation. Water sector have many problems such that agricultural water and untreated water are mixed while it transfers from public extension to private business. I wish them make change their dependence on our assistance; on the other hand, they are becoming treat with problem themselves. I want to keep going to improve water supply in developing country.

My dream is to make an African version of WaQuAC-Net, which is the stage of the exchange of techniques and people. I want to learn many things from WaQuAC-NET.



4. Activity in the world

<Special REPORT> My Activities & Current Water Supply System in Yangon, Myanmar

**Mr. Masaru MATSUOKA,
(Fukuoka City Waterworks Bureau)**

Mr. MATSUOKA had been dispatched to Yangon City Development Committee (hereinafter referred to as "YCDC"), Republic of the Union of Myanmar as a JICA Expert for Water Supply Management from Fukuoka City Waterworks Bureau for 3 years from April, 2012. He was the second JICA expert in Myanmar following Mr. Daishi NAGASHIO who had been dispatched for 2 years from 2002. Mr. MATSUOKA gave a presentation about his activities in Yangon at the WaQuAC-NET Kyushu Branch General Meeting on August 1st. (by Yamamoto)



Mr. MATSUOKA

Table 2 General information about Yangon

Yangon	
Population	Approx. 5.21million (2013)
Area	Approx.599km ²
Annual mean precipitation	2,681mm
Annual mean temperature	Max. 32.3°C Min. 22.6°C
Climate	Tropical monsoon
Location	Long. 96° E. Lat. 17°N.

2. Geography and History of water supply in Yangon

1) Geography

Yangon City is said that water source is not enough by following reasons;

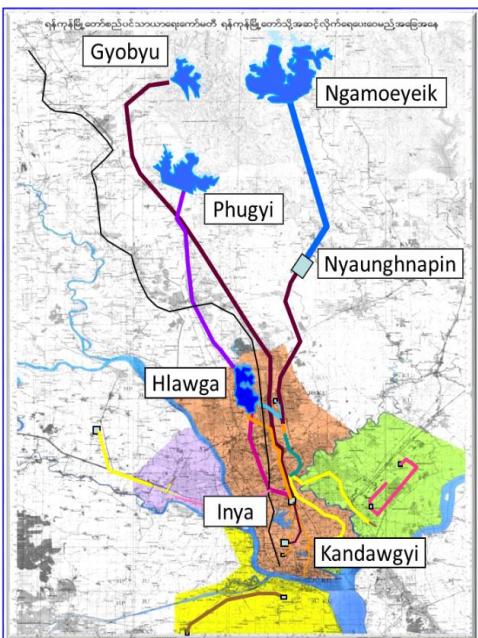
- It is difficult to use river water in Yangon area for salt water intrusion.
- It is forced to construct dams for water supply in far away area from the center because Yangon City is in flat land mostly.
- It is necessary to construct relatively big dams to supply water constantly because there is dry season from November to April.

2) History

YCDC has been managing water supply system by them for a long time. It is said that water supply in Yangon has begun in 1842 with 30 tube wells in downtown. YCDC has been using some reservoirs and pipes which were constructed in British colonial period mostly. In recent years, YCDC designed and constructed new water purification plants, Nyaunghnapin WPP (Phase1&2), by themselves.

Table 1 General information about Myanmar

Republic of the Union of Myanmar	
Population	Approx. 51.4 million (2014)
Area	Approx. 656,578km ²
GDP	42.9billion USD
GDP/p	702 USD
Capital	Nay Pyi Daw
Official language	Burmese

**Figure1 Location of reservoirs, WPP****Table 4 Yangon Water Supply in 2011 & 2040**

	2011	2040 (target year)
Population	5,142,000	8,520,000
Served population	1,920,000	6,810,000
Coverage rate	38 %	80 %
Leakage rate	50 %	10 %
Unit domestic consumption	95 litters	178 litters
Max. daily water demand	673,100 m ³ /d	2,467,300 m ³ /d

2) Business plan

There are a project implementation plan in single fiscal year and a long term master plan in YCDC, but there are not any multiple years business plans because the water utility account is not independent and so on. Therefore, it seems that YCDC doesn't consider collecting water charge properly. It is collected by staffs every month and there are 3 water charge category. The charge of connection with meter is "100 Kyat (basic charge) + 88 Kyat/m³ (commodity charge)". The flat rate is "1,875 Kyat every month" and religious building one is free. YCDC has been changing flat rate connection (without meter) to one with meter. Staffs are trying to install meters on religious building connections.

3) Unsystematic distribution facilities

It is difficult to supply water to customers constantly because water is supplied to customers directly from the reservoirs and water purification plant due to the less number of distribution reservoirs. And it is also difficult to maintain distribution facilities because the served area is not divided into some DMAs. These situations also cause low water pressure, so most of customers had to install booster pumps on their own. In addition, some pipes of tube wells are connected with distribution pipes for supplying more water to customers in the end of distribution area. There, customers can acquire water only for a few hours a day. And there are several service pipes laid in parallel for a few hundred meters on the ground from distribution pipes in main road for getting water.

Table 3 Capacity of reservoirs

Year	Water sources	M ³ /d
1842	30 Tube wells in downtown	-
1879	Kandawgyi Lake	stop using
1884	Inya Lake	stop using
1904	Hlawga Reservoir	64,000
1940	Gyobyu Reservoir	123,000
1989	Phugyi Reservoir	245,000
2005	Nyaunghnabin WPP (Phase1)	205,000
2013	Nyaunghnabin WPP (Phase2)	205,000
	Ground water	91,000
	Total	933,000

New WPP project, which water source is the existing Lagunbyin reservoir, is underway to supply water to uncovered eastern Yangon area and Thilawa SEZ by JICA's assistance. Its production capacity is 182,000 m³/d and one quarter of production volume will be sent to Thilawa SEZ.

3. Current situation & issues

1) General information on water supply in Yangon in 2011

General information about water supply in Yangon is as following table 4 according to the "Water Supply System Master Plan" in 2013 that YCDC formulated with JICA's assistance. YCDC has been implementing some projects based on the Master Plan since 2013.

Figure 2 Several service pipes in parallel on the ground



4) Low coverage rate

The coverage rate in 2011 was only 38% and average daily supply hour was 7.8 hours. The supply hours has increased after starting operation of Nyaunghnapin WPP Phase 2 since 2013.

People living in uncovered area buy water of 400 Kyat in 230 liters from water seller daily. The water is drawn from a pond managed by YCDC.

They also use rain water stored in the tank in front of houses or use water drawn from tube wells.

5) High NRW rate

NRW rate in 2011 was about 66%. It was much higher than ones of major cities in Southeast Asia. Those main reasons are considered as physical losses; leakage from transmission, distribution and service pipes, and as commercial losses; illegal connections, damaged water meter & bad performance water meters, meter reading errors and human errors for hand writing jobs during the process of water charges collection.



Figure 4 Repairing Leakage on transmission pipe

6) Disinfection

There was only one disinfection facility in Yangon but it has been out of order for 2 years, so all of

water supplied by YCDC have been not disinfected.

II. Activities as a JICA Expert

I had 7 activities on TOR; collecting data & improving database, advising & making suggestions for water supply management, considering improvement plan of water service & future assistance programs, transferring techniques of water distribution management, organizing technical training trips and so on. I implemented a lot of activities during 3 years. I introduce main activities.

1. Technical transfer for NRW reduction

1) Inspection on Gyobyu transmission pipeline

My counterparts and I inspected dia.1400mm transmission pipeline which length is 68km from Gyobyu reservoir to Kokkine distribution reservoir and it has been used since 1940. Inspection tour took 9 days to identify the locations of leakage, unregistered connections and valves by digital camera with GPS function and Google map. As a result, we identified 9 main valves, 60 air valves, 37 drains, 89 leakages and 95 unregistered connections on the map.



Figure 5 Inspection members

[Issue 1] The amount of leakage was estimated at approximately $610\text{m}^3/\text{d}$ (423 liter/minute) as following table 5. NRW rate is approximately 0.5%. The number of NRW rate seemed to be small, so I explained to YCDC's staffs for aware of the importance of leakage reduction that the amount of leakage could be supplied to about 6,100 people and that it meant YCDC lost about 2,000 million Kyat every year. Besides, I suggested that they find leakages and to repair them immediately by regular

inspection.

Table 5 estimated leakage amount

Location of leakages	No.	L/m	M ³ /d
Main valve	1	1.00	1.44
Drain	11	94.96	136.74
Air valve	29	63.04	90.78
Joint	7	19.51	28.09
Main pipe	3	80.00	115.20
Branch pipe	30	129.15	185.98
Branch for pressure gage	4	22.02	31.71
Pumping station	3	13.65	19.66
Total	89	423.83	610.32



Figure 6 Gyobyu pipeline

[Issue 2] The amount of unregistered connections was estimated 59,000 m³/d. 1.9 billion Kyat would be lost every year for them. I suggested that they find other unregistered ones by regular inspection and then install water meters for collecting water charges based on the water consumption.

2) Pilot project for NRW reduction

I implemented a pilot project for NRW reduction in Yankin Township to transfer techniques of water distribution management to YCDC staffs. Before the project, there was not distribution pipe network in the area, so customers had to lay long service pipes on the ground on their own. And there were about 300 customers and inflow rate was estimated at 75,000m³/month, NRW was at approximately 75% and YCDC was supposed to lose 4,950,000 Kyat every month and 59,400,000 Kyat every year.

Firstly, I estimated future water demand and collected data of elevation, pipe length and so on. And then I simulated using the EPANET by

considering water pressure & flow rate, for deciding diameters of pipes. Location of valves were decided by considering future maintenance like filling water to pipeline network and suspension of the water supply for repairing leakage.

Next work was to make the specifications of materials; water meters, valves and so on by considering ISO and Japanese standard. I obtained the JICA assistance of 16,000,000 JPY to procure HDPE pipes; 1200m of dia.150mm and 4,700m of dia.75mm, valves, fire hydrants, 300 units of dia.20mm water meters and so on. YCDC engineers laid distribution pipes with connection of service pipes and installation of water meters by YCDC budget. Fitting type of HDPE was *butt fusion*. When I surveyed the condition of water supply to customers and evaluate the result of project after the completion of all works in pilot area, customers were very satisfied with enough water pressure to send water to overhead tank. And NRW rate was decreased from 75% to 15~20%. Now, most of existing NRW causes from free religious building connections. I was very glad to hear that YCDC started to develop distribution pipeline network in other areas based on this pilot project.



Figure 7 Digging for laying pipes & water supply after completion of the project

3) Assistance for design of transmission & distribution facilities

I explained the necessity of distribution reservoir and the effective capacity of reservoir with graphs of changes of hourly water supply amount a day in Fukuoka City. And I designed transmission pipes, a distribution reservoir, main distribution pipes and distribution pipeline networks to implement the

project for supplying water in uncovered area with YCDC engineers who I transferred techniques.

4) Distribution pipeline map & accumulation of leakage data

I made maps of new distribution pipeline for the proper maintenance of distribution facilities. The maps were unified in A1 size in all areas of the city.

YCDC engineers drew pipeline on the map by different color by each different pipe diameter using FRIXION pens. Pipe materials, years installed, valves and other facilities were drawn on the maps as long as they knew. I recommended them to update the data on the maps when they installed new pipes.

I also supplied them A1 pipeline maps and 4 color stickers for putting stickers on the leakage points on the map. Color of sticker was changed by different facilities. For example, pink stickers were put on transmission leakage points, green ones were put on distribution pipe leakage points and so on. And then, Leakage points were accumulated on the map for understanding the trend of leakages and prioritizing the replacing pipes and areas for detecting leakage.

Furthermore, I made and distributed a format of leakage repair report and the report in Myanmar language as example for accumulating data and information of leakage for improving leakage repair techniques.

5) Site survey on conditions of water meters & service pipes

I implemented following activities to reduce commercial losses among NRW; improvement of procedure of water charge collection, making the customer database and implementing site survey in the whole YCDC area on conditions of water meters & service pipes with YCDC engineers, because I had realized that 90% of 120 water meters in the pilot project area were not working properly due to damaged displays and low quality materials. The survey has not finished yet. But they will be able to recognize which meters should be replaced to new

ones with this survey and commercial losses will be reduced.

2. Daily life in Yangon & future assistance

I was always impressed with kindness of Myanmar people very much for three years. They helped me naturally anytime I faced any problems. I was very happy to see their pure smiles.



Figure 8 Myanmar girl



Figure 9: Kyauktawgyi Pagoda in Yangon



Figure10: Shwedagon Pagoda in Yangon

"Memorandum of Understanding on Cooperation and Support for Urban Development between Fukuoka City and Yangon City" was signed by both mayors in Yangon in May, 2014 during my stay in Yangon. They hope the relationship of both cities will be stronger. As for the Japanese assistance on water sector in Yangon, some projects by grant aid, loan and technical assistance have already been implementing and next JICA long term expert as adviser for management of water & sanitation is dispatched for 2 years from August 2nd from Fukuoka city again. I would like to cooperate to Yangon water supply system continuously. (end)



Figure 11 YCDC Counterparts