Best Practice: Water Leakage Prevention Controls

REPORT UPDATED: JANUARY 30, 2012

CITY: TOKYO **POLICY AREAS: ENVIRONMENT; ENERGY**

BEST PRACTICE

The City of Tokyo's Bureau of Waterworks leads the world in the field of detection and control of water leakage technology. Compared with other large cities, Tokyo maintains an extremely low rate of water leakage from its vast network of underground pipes. Tokyo's water supply serves approximately 13 million residents and water is supplied by four rivers – Tone, Ara, Tama and Sagami. Untreated water from these rivers is purified through three processes at local plants – coagulation, sedimentation and filtration. Untreated water from Tone and Ara rivers are additionally processed by ozonation and biological activated carbon adsorption treatment. The treated water is then pressurized and supplied to customers as tap water through underground pipelines.

The total length of distribution pipes is over 26,000 kilometers (16,155 miles). Leakages are repaired on the same day that they are reported. Efforts are made to carry out early detection for leaks and the Bureau regularly replaces pipes and improves pipe materials (i.e. from cast iron to ductile cast iron for distribution pipes). In the mid-1980s, there were about 58,000 cases of leakage repairs. In 2008, reports of leakages dropped to about 15,000 cases and has been decreasing since.

ISSUE

Tokyo Metropolitan Government stores and distributes 6.3 million square meters (about 6.8 million square feet) of water per day. A major challenge facing the Bureau of Waterworks is the insufficient intake of water due to river-bed degradation. The Tone river system, which accounts for 80% of the overall water resource of Tokyo, is not as protected against drought as compared to other river systems since dam construction is incomplete and recent changes in precipitation patterns.

As of Fiscal Year (FY) 2010, there were over 26,000 kilometers (16,155 miles) of distribution pipes under the Tokyo metropolitan area. Water pipes laid underground are constantly exposed to the danger of leakage, and the leakage can cause secondary disasters such as poor water flow, road collapse, and flooding of the buildings and inundation.

- In FY 1956 the leakage rate was 20%
- In FY 2010 the leakage rate was approx. 3.0%

Most leakage is caused by:

- 97% cracked or corroded pipes service pipes
- 3% aging distribution pipes

In addition to routine checks and repairs, renewal of aged pipes and replacement of lead feeder pipes with stainless steel pipes are a major priority. This has succeeded in reducing vast amounts of water leakage over the past 50 years.

Amid prospects that climate change will affect water resources, it has become increasingly important to prevent water leakage to ensure maximum utilization of limited water resources. The value of leakage prevention is equivalent to new water resource development.

GOALS AND OBJECTIVES

The overall goals are to make the best use of limited water resources, to adapt to climate change, and to prevent collateral disasters caused by the water leakage, such as shortages in water supply, depressions and cracks on surface streets due to groundwater drainage, accidental flooding into buildings and so forth.

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IMPLEMENTATION

In addition to routine checks and repairs, renewal of aged pipes and replacement of lead feeder pipes with stainless steel pipes is a major priority.

Specific measures include:

- Underground leakage: Leaks are detected by using electronic leak detectors. The potential leakage quantity is estimated by using night flow measurement tools.

- Replacement of pipes and improvement of pipe materials: From cast iron to ductile cast iron for distribution pipes as these have higher strength and better earthquake resistance; from lead to stainless steel for service pipes laid under public roads.
- The K-Zero project (K stands for Keinen-kan in Japanese which means "aged pipes") has been in place since 2002. The project was launched to completely replace existing aged large-diameter pipes (400 mm or over) with new pipes. As of today, 99% of the old pipes have been replaced.
- Monitoring of service pipes: these account for 97% of the total number of leakage repairs so early prevention of leakages is essential.
- Training and Technical Development Center: This center was newly established in 2005, and has been contributing to leakage prevention through research and development.
- Computerized system: This calculates and gathers information on leakages. Data collected includes the causes, details of each repair case, and the cost for repairs.

Energy Saving System
The City's Water Supply Operation Centre manages all data relating to water supply through a computerized system which monitors and controls activities 24 hours a day, 7 days a week. This ensures that water supply is stable from the purification plants and water supply stations. The system contributes to the efficient management of both water supply and pump operation.

Water-saving equipment
The City also requests that manufactures develop and supply water saving equipment including, taps, tap plugs, toilets, and washing machines. These are being fitted wherever possible throughout the system. Water-saving plugs were also developed and distributed to customers for free.

COST

In FY 2010, Tokyo's Bureau of Waterworks spent ¥6 billion YEN ($54.5 million USD) on its water leakage control activities.

RESULTS AND EVALUATION

- Tokyo's focus on same-day repair work has helped to drastically reduce the leakage rate, from 20% in 1956 to approximately 3.0% in 2010.
- The amount of CO_2 emissions reduced by diminution of leakage rate is about 67,100 tons of CO_2 (equal to the amount of carbon dioxide emitted by about 61,600 cars).
- The amount of electricity converted from the volume of water prevented from being wasted (with respect to the amount of the wasted in 1956) was about 164MkWh in FY 2010.

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- The electricity charges saved by diminution of leakage rate (with respect to the amount of the wasted in 1956) is about ¥2.4 billion yen ($23.6 million USD) in FY 2010.

TIMELINE

1945 Leakage rate 80%
1955 Leakage rate 20%
1960 Adoption of a ductile iron pipe to a distribution pipe
1980 Adoption of a stainless steel pipe to a service pipe
1992 Leakage rate 10.2%
2007 Leakage rate 3.3%
2008 Leakage rate 3.1%
2009 Leakage rate 3.0%
2010 Leakage rate 2.7%

LEGISLATION

Tokyo Metropolitan Government launched the project without legal enforcement.

LESSONS LEARNED

In recent years, leakage prevention efforts have grown increasingly more difficult to maintain at the Bureau of Waterworks due to a decreased number of experienced staff and increased volume of road traffic. With limited staff, the focus is on technology fostered to date.

The Training and Technical Development Center, established in 2005, is one of the largest facilities for waterworks training, research and development in Japan. Staff training is based on real case studies and continues to be critical to the success of the Bureau. The Center is also currently developing new leak detection equipment to improve efficiency.

TRANSFERABILITY

Tokyo's water leakage control activities have been highly successful in both reducing CO_2 emissions and in energy and cost savings.

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Facts and figures in this report were provided by the highlighted city agency to New York City Global Partners.