Data Measuring Device for Water Pipe Network Keeping on Operating Even in Case of Disaster

the international water association

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Background

The Bureau of Waterworks, Tokyo Metropolitan Government is one of the largest waterworks entities in the world, serving a population of approximately 13 million people, with facilities capacity of 6.86 million m³/day, and a network of approximately 27,000 km of pipes. Water pipes spread from wide, trunk roads to narrow side streets in all directions, and water is supplied constantly to every single terminal at an appropriate pressure. Data-measuring devices for this water pipe network are called “telemeters” and they monitor the flow of water 24 hours per day.

The Bureau launched the planned installation of telemeters in 1969, and now there are approximately 300 telemeters across Tokyo. Each telemeter measures water pressure and other data in the pipe network, and transmits this data to the Water Supply Operation Center. Collected data is utilized to control pump operation in purification plants and water supply stations, as well as to detect abnormalities in the pipe network. Thus, telemeters are crucial devices for stable water supply (Figure 1).

However, after the Great East Japan Earthquake struck in March 2011, due to the shutdown of nuclear power plants and other factors, planned blackouts were carried out in Tokyo to control the supply of electricity. Consequently, some telemeters stopped working because of the lack of electricity. In these circumstances, the Bureau could not collect data on the water pipe network. Today, the occurrence of an earthquake with its epicenter under the Tokyo metropolitan area has been indicated as a major threat, and in the event of such an earthquake, it is essential to have equipped telemeters with an uninterruptible power source from rechargeable batteries, in order to ensure stable water supply after an earthquake. In this poster, we report on the project to install uninterruptible telemeters equipped with rechargeable batteries, which has been underway since 2012. The purpose of this project is to reduce risks from disasters, taking into account the lessons learned from the Great East Japan Earthquake.

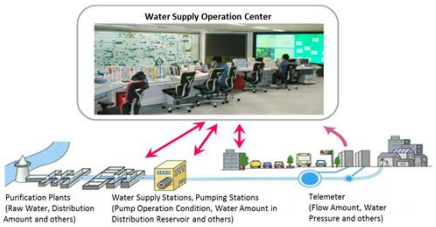

Figure 1 - Data collection system for distribution pipe network using telemeters

Telemeter Installation Method

There are two options for telemeter installation; one is aboveground and the other is underground. Aboveground telemeters have their measurement devices and data transmission devices inside the casing placed on the ground (approximately 600 mm wide, 600 mm deep, 1500 mm high) (Figures 2, 3). Underground telemeters have them inside a concrete telemeter box, which is constructed underground (Figures 4, 5).

The Tokyo Waterworks installs aboveground telemeters on land belonging to the Tokyo Waterworks and on wide streets. Yet, a great number of major pipes from which we collect water pressure and other data are laid under narrow side streets, and telemeters in these locations must be installed underground. Underground telemeters now account for approximately 30% of all telemeters.

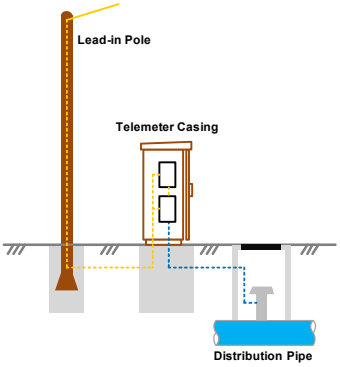

Figure 2 - Layout of Aboveground Telemeter

Figure 3 - Picture of Aboveground Telemeter

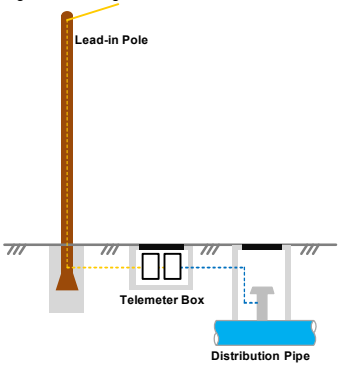

Figure 4 - Layout of Underground Telemeter

Figure 5 - Picture of Underground Telemeter

Challenges and solutions in installing uninterruptible telemeters

The Tokyo Metropolitan Government has a plan install uninterruptible telemeters by equipping them with rechargeable batteries that enable telemeters to function for approximately 3 days after the loss of power supply, in order to collect data from the pipe network continuously. Telemeters normally work by storing power from electric power companies, and in the event of a blackout, automatically switching using power from rechargeable batteries, in order to continue measurement and data transmission uninterrupted.

In aboveground telemeters, the casing can easily fit batteries inside (Figure 6). However, in underground telemeters, space inside the telemeter box tends to be small because road width is narrow and there is a need to avoid densely laid pipes. This makes it difficult for a telemeter to have enough space inside for batteries with capacity to supply power for 3 days. This situation forced the Tokyo Waterworks to replace underground telemeters with aboveground telemeters. Still, installing aboveground telemeters entails a serious challenge, as they must make the most of space on the road in order not to avoid causing traffic disturbances.

To solve this problem, the Tokyo Waterworks improved the shape of telemeters to fit in narrow roads by making the casing thinner (Figure 7), or by combining a lead-in pole with the casing (Figure 8). One advantage of telemeters with a casing combined with a lead-in pole is their compact size. It consists of a prism-shaped casing on the lower part (approximately 350 mm wide by 350 mm deep), and a cylindrical pole on the upper part which serves as a lead-in pole. This type of telemeter requires only 20% of area required to install a standard aboveground telemeter with a separate lead-in pole. Furthermore, in small areas which cannot allow even the installation of a combined type telemeter, the Tokyo Waterworks places a casing with built-in batteries on the upper part of a lead-in pole (Figure 9). Thus, we examine every single location closely according to each installation environment, taking into consideration the best method for each installation.

Figure 6 - Aboveground telemeter equipped with rechargeable batteries

Figure 7 - Thin-type telemeter

Figure 8 - Telemeter with combined casing/lead-in pole

Figure 9 - Pole-mounted rechargeable batteries board

CONCLUSIONS

Thus far, the Tokyo Waterworks has completed approximately half of the project to install uninterruptible telemeters with rechargeable batteries, which was started in 2012.

In October 2016, when there was a major blackout caused by a cable fire at an electric power company, 580,000 households in Tokyo were affected. However, telemeters with rechargeable batteries continued to measure data. Therefore, the Tokyo Waterworks was able to retrieve data from the pipe network and deal with the situation appropriately. Eventually, stable water supply was secured. The Tokyo Metropolitan Government will continue this project to replace conventional telemeters with uninterruptible telemeters intensively until 2022.

The Tokyo Waterworks is determined to further enhance measures against disasters by providing uninterruptible telemeters equipped with rechargeable batteries, which protect stable water supply from loss of power in case of accidents or disasters.