Establishing a dual transmission system using the portable pump of an engine drive

Y. Mori*, Y. Hasegawa, Y. Konno, T. Takahashi, S. Ogata

*Sendai City Waterworks Bureau, 29-1 Minami-Onoda, Taihaku-ku, Sendai City, Miyagi, Japan, yuuta_mori@city.sendai.jp

INTRODUCTION

Sendai is the capital city of Miyagi prefecture, and is located in northeastern Japan. Sendai is the largest city in the Tohoku region. The Sendai City Waterworks Bureau supplies 1.05 million citizens with 327,000 tons of water every day. We have taken various steps to create a resilient waterworks supply against the threat of disasters and accidents. Natural disasters and accidents threaten the safety of our water supply. This report will introduce the portable pump of an engine drive as one of the examples of an emergency backup system.

We supply water to citizens from four main purification plants and four small purification plants. Our main water resources are from dams in the western mountain area. The feature of our water supply is to use gravity flow, which enables us to distribute water by using fewer transmission pumps. We receive treated water from 9 points of the Miyagi Prefectural Bulk Water Supply. The water is treated at a purification plant located in the southern part of Miyagi pref. and supplies to Sendai city and other areas through water pipes with a maximum diameter of 2,400 mm.

In addition, our purification plants and water distribution facilities are connected via the distribution main pipes. This enables each independent distribution system to mutually support the other. We manage the water supply by using these systems aiming at securing a stable water supply and reduce the impact on citizens at the time of disaster.

BACKGROUND

A water leakage was found at the Miyagi Prefectural Bulk Water Supply in April, 2008. The leakage was actually found from the water supply pipe with a nominal diameter of 900 mm in the Low-zone service system of the Miyagi Prefectural Bulk Water Supply. We mainly supplied water to southern areas of Sendai through this pipe, and therefore about 12,000 households experienced a water cut-off or experienced turbid water for three days until the repair works were done (Figure 1).

In the wake of this incident, we started to consider establishing a dual transmission system. After careful consideration, we decided to establish a dual transmission system in Tsubonuma, Taihaku and Nishikigaoka areas. In this report, we will explain this system by showcasing an example of using a portable-sized engine pump in the Nishikigaoka area.

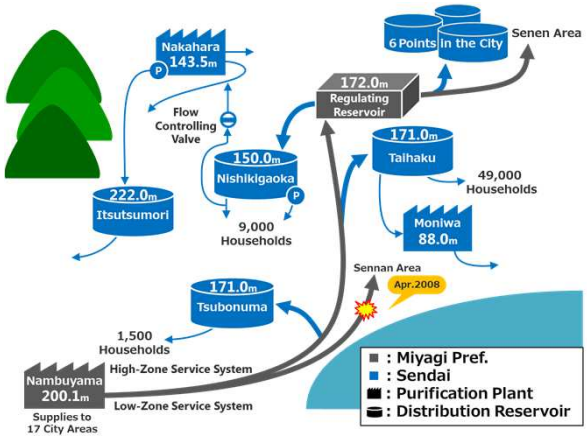

Figure 1 – A Water Leakage Found at the Miyagi Prefectural Bulk Water Supply

METHODS

The water pipe of the Miyagi Prefectural Bulk Water Supply and the Sendai City water pipe aren't connected at present, and therefore we have to lay an emergency water pipe. In addition, the highest water level of the Nishikigaoka Water Distribution Reservoir is 150.0 m, and the reservoir only receives water from the Miyagi Prefectural Bulk Water Supply, while the highest water level of its nearest water purification plant is 143.5m. So in order to establish a dual transmission system as backup, it requires pump equipment to be installed at the distribution pipe (Figure 2). The required pump capacity is a 20m pump head with a 4.6t/min of water supply.

The system was scheduled to be completed in 2024 in accordance with land acquisition for developing a pump facility. However in December, 2016, a water leakage was found in the water supply pipe in the high service system of the Miyagi Prefectural Bulk Water Supply. For this water leakage repair, the Miyagi Prefectural Bulk Water Supply has to stop water supply to Sendai City. We front-loaded the plan partially to cope with this cut-off of water supply. We then decided to precede by installing only the pump equipment first.

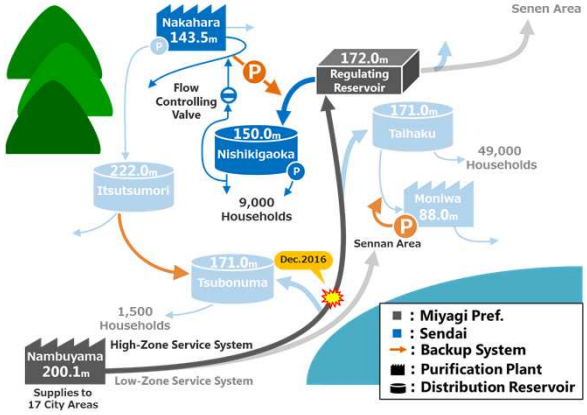

Figure 2 – Areas in Need of a Dual Transmission System

DISCUSSION

This time, we chose to install the diesel drive pump unit from an emergency point of view. The reasons for choosing this pump unit are as follows;

1) It is not necessary to have large scale electrical equipment such as high-voltage substation facilities or private electric power generators as a measure against blackouts.

2) It is easy to control the volume of water supply by changing the engine speed.

First, we did a preliminary calculation of expenses for installing the pump unit. We found out that in general more than 100 million yen is needed, but since this pump unit was a package deal we were able to install the unit with approximately 20 million yen (Figure 3).

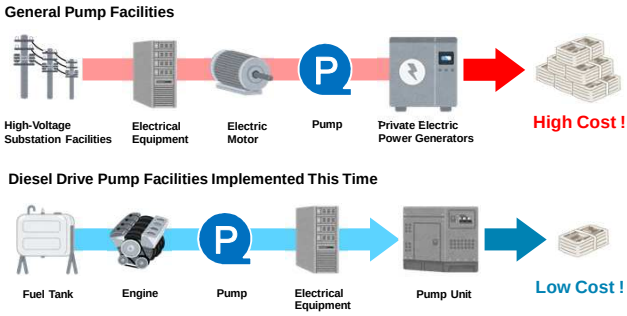

Figure 3 – Comparison of Pump Facilities by Difference in Motors

RESULTS

We were able to carry out the actual water supply pipe repair work without cutting off water because we were able to receive water from a reservoir tank after talking with Miyagi Prefecture and other related water supply corporations.

However, we decided to carry out a practical water supply test in order to check the performance of the pump unit we purchased. The test run was performed in April, 2017 (Figure 4). We used a temporary lease pipe and the result of the test was satisfactory (Figure 5).

Figure 4 – The Test Run in Action

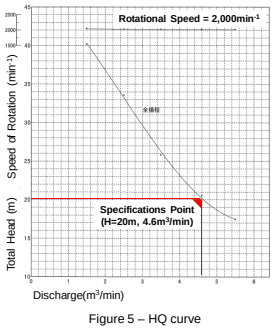

Figure 5 – HQ curve

CONCLUSIONS

Accidents occur at random and we cannot expect when they will happen. That is why we must make various emergency preparation measures including enhancing equipment, to make a disaster-resilient waterworks.

In general, investment in enhancing equipment costs a lot. However, this pump unit enables us establish a dual transmission system with low costs (Figure 6). If it is within your performance curve range, our method may meet your needs.

Figure 6 – Pump Unit