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Issue 2 | 2018

Publishing House:
DIV Deutscher Industrieverlag

ISSN: 2509-2731

WATERSOLUTIONS

Water & Waste Water Technologies

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INDUSTRIAL WATER
ACHEMA 2018

One block from the White House – leaker identified and caught on video

In order to detect possible leakage and evaluate the general pipeline condition, the District of Columbia Water and Sewer Authority, DC Water, decided to optically and acoustically inspect one of the oldest parts of the Washington D.C.'s drinking water network.
A 670m (2,200ft) section of a cement mortar lined cast iron main - installed in 1888 - was subject to be investigated by MTA Pipe-Inspector® multisensory technology.

First insights after 130 years

The District of Columbia Water and Sewer Authority (DC Water) is an industry leading, multi-jurisdictional regional utility that provides a reliable water transmission system to over 680,000 residents, 16 million annual visitors and 450,000 people commuting to employment within the city limits every day.
DC Water's oldest cast iron pipe still in service was installed in 1858, just as its population was achieving 75,000 residents. These pipes were primarily used for public hydrants as fire protection. Over 160 years, these pipes are now connected to the entire system supplying treated drinking water as well as fire water. The average age of DC Water's underground water supply pipes is almost 80 years, with over 480km (300 miles) of its 2,100km (1,300 miles) over 100 years old. On average, 400 to 500 water main breaks occur each year in the city, mostly during the winter. As the mains age, the number of leaks in the system increases. Joint leaks, a major cause of DC Water's revenue loss on older mains, are difficult to locate because many of the city's water mains have been laid under streets surrounded by numerous other underground utilities. In this situation leaks do not easily surface and instead follow along any underground pipe until the water reaches a wastewater sewer, electrical vault, or some other easy point of escape. Unidentified leaks represent a significant portion of the 20% of the water that never reaches a customer meter.

Cable-less multisensor inspection

DC Water addresses this problem of underground leaks by considering new improvements to leak detection technology. Personnel became aware of MTA Messtechnik GmbH in 2017 and were intrigued with the capabilities of a cable-less video inspection with integrated acoustic leak detection simultaneously providing other in-pipe data such as temperature, pressure and distance.
DC Water chose an 1888 cement mortar lined cast iron potable water main as a pilot project with MTA Pipe-Inspector. The pipe was predominantly 600mm (24") with an inline reducer to 500mm (20"), with a total length of 670m (2,200 ft.) along 14TH Avenue, running parallel to The White House and grounds but one block away. Just for a challenge, this pipe also contained three horizontal butterfly valves which could impede an in-pipe inspection. Because of these obstructions, it was determined that of the five available sizes of MTA Pipe-Inspector tools, the DN125 (5" diameter) would be most appropriate to minimize risk of getting stuck on a valve. It was identified that the pipe would require no pressure adjustments, as the standard operating pressure is 4bar (60psi) which was well above the lower limit for acoustic leak detection of 1bar (14.5psi).
DC Water was in charge of providing a continuous supply of water in adequate quality, pressure and quantity for the entire duration of the investigation. All site traffic safety and security was also its responsibilities to ensure compliance with local regulations.
DC Water provided its own competent local forces to make the necessary modifications for the start and end points by means of hot tapping with valve and flange fittings as well as onsite assembly and dismantling of parts required for the implementation of the project. Final restoration was also by DC Water.
Tentative dates for site preparation and investigation activities were determined once a MTA "Checklist" was completed by DC Water to confirm that operational conditions and deployment configurations would be achieved. It was determined that pipe preparations would be commenced during the two weeks prior to the set survey deployment date of November 6, 2017.

More security in an emergency case

These activities included developing an "Isolation Plan" which meant that operators would need to open and close branch valves from this water main that served other streets and main building fire systems and drinking water. During this necessary valve testing exercise, some mainline valves were found to be inoperable, and were replaced immediately. This action improved the system in case of an emergency and if further rehabilitation or repairs were needed as a result of the MTA survey.
Permitting was a factor in the planning stage. Due to the anticipated short duration of the survey, a three day Emergency Works Permit was obtained, in addition to inclusion of the work under a normal manhole access permit. The extraction location was directly in front of the US Department of Commerce headquarters, incidentally who's main purpose is to encourage sustainable development and improve standards of living for all Americans. It was necessary that a formal notification and that a disruption in their water service was accepted by the Department.

During planning meetings, it became apparent that the intended locations for the access into the pipe would need to be re-evaluated due to pedestrian and traffic movement, buried utilities and streetscape. By the time access locations were field verified and finalized, the inspection distance became 2,200 linear feet, starting north of New York Ave and ending north of Constitution Ave in front of the Ronald Reagan Building and International Trade Center.

Access on a six lane urban street

The starting access location was ideally situated well away from the intersection and would limit the road closure requirements to two lanes of this six lane street. Near the Pennsylvania Avenue intersection, the 600mm (24inch) main reduced to a 500mm (20inch) diameter main and meandered to become located under the sidewalk, therefore requiring only one lane traffic reduction.

Roughly 25 minutes from plunging the MTA Pipe-Inspector into the pipe it was tracked and confirmed that it had arrived at the retrieval location. Once the locator confirmed this, the in-line valves were closed, as well as the hydrants, and the flow was stopped.

Flow rate and turbidity

Actual wall thickness was confirmed by measuring the pipe coupons retrieved from the pipe tapping operations prior to the deployment date. It was also noted that the pipe was cement mortar lined, and the lining still adhered to the host pipe after all these years in operation.

As darkness set in on the night of the work, crews were mobilized, traffic control was set up, and the contractor selected by DC Water removed road plates that had covered their previous preparation pits accessing the main. As a video record of the survey was required, it was important to obtain turbidity readings prior to the start of the survey. Turbidity was tested at the insertion and extraction location to be within normal acceptable range to enable clear video imaging.

The flow rates were checked with an ultrasonic flow meter at the retrieval point and found to be within the 0,5m/s (1.75 ft/s) minimum and 1,5m/s (5 ft/s) maximum, and pressure was verified at around 4bar (60psi), and the work was set to start. Two downstream hydrants were opened and adjusted to manipulate the flow to achieve 200l/s, which equated to a velocity of 2.33ft/s in the 600mm/24inch pipe, and 3.35ft/s in the 500mm/20inch pipe.

Prior to deployment, the start point and end point were prepared with T-pieces and valves to be able to connect insertion and retrieval sluices containing the MTA Pipe-Inspector system. The insertion sluice was attached at the valve at the start point. To minimize the quantity of air introduced to the pipeline by inserting the inspection device the pipe was filled with water.

Access and retrieval point

The retrieval sluice was attached at the valve at the end extraction access location. It was utilized to insert a retrieval net which covered the complete main pipe inside diameter to catch the MTA Pipe-Inspector tool. Before the assembling of the retrieval sluice and retrieval system, all components of the catching net were disinfected with a liquid disinfectant.

The entire retrieval system was installed in place prior to final preparation at the start access location. This eliminated the risk of accidental deployment of the tool into the pipe and potential loss in the system once the flow was restored. Since the device had to pass 3 horizontal butterfly valves, the inspection tool required ballast modification to ensure the device was running through the pipe as close as possible to the bottom ground level of the pipe. This necessary adjustment meant that the optical inspection would be focused on the lower part of the pipe.

Device tracking and retrieval

Once the MTA Pipe-Inspector tool itself was disinfected and inserted into the sluice, the sluice valve was opened to allow

Source: MTA Messtechnik

Start access sluice valve installed by DC Water forces

Source: MTA Messtechnik

Retrieval access sluice valve installed with riser piece

Source: MTA Messtechnik

Plunging sleeve connection typical at both access points

MTA Pipe-Inspector DN125 continues to operate after extraction until turned off and on-board data extracted to computer for immediate video review and data analysis

the inspection device to be plunged into the main pipe and start the inspection run. Due to the emitted signal the MTA Pipe-Inspector was tracked along the main pipe until it reached the retrieval net at the end-point.

The catching net was pulled back into the retrieval sluice and the valve below the sluice was closed to disconnect the sluice from the main pipe. By slightly opening the top flange, the pressure inside the sluice was released and the inspection device was taken out for downloading the inspection data.

Revelations and recommendations

Pre-inspection line isolation and coordinated flow manipulation during the inspection between MTA and DC Water operations proved the ability to control the deployment within the pipe, eliminating the possibility of losing the device in the system. Tracking the device from the surface and vertically up the retrieval sluice demonstrated MTA's deployment control confidence.

The temperature and pressure data recorded by MTA Pipe-Inspector inside the pipeline did not show any anomalies. The recorded pressure difference inside the pipe from the start point to the end was 14.5psi (1bar) which matched exactly the difference in altitude between the two points. The optical evaluation revealed the condition of the three valves in addition to identifying several deposit areas where some of the cement mortar lining had dis-bonded from the cast iron pipe.

The first identified leak, located near the entry point street intersection, was very small and therefore not deemed to require further actions aside from future monitoring at this point in time. It was located south of a branch line on the right side of the flow direction. The ability to provide a clock position in this case identified the leak as a possible service connection leak.

The second leak, while being rated as larger, yet overall considered to be small, was further down along the pressure pipe. This location was almost equidistant between a branch on one side, and two branch tee connections running perpendicularly in both directions.

MTA recommended that a water loss analysis should be initiated to quantify the real water loss from the leakages prior to planning for further actions. In addition, to get a total 360 degree detailed optical overview of the interior pipe condition, a second MTA survey could be set up to run along the top side (obvert). Prior to any excavation for a leak, it was recommended that the leak position be verified by another technology, such as geophones or standard leak detection technologies.

DC Water is continuing cable-less video inspections of more segments of their aged cast iron water pipes using the MTA Pipe-Inspector in 2018. The data will be used by engineers to provide an existing condition based asset management evaluation for further remedial actions, based on multiple sources of pipe operational conditions.

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