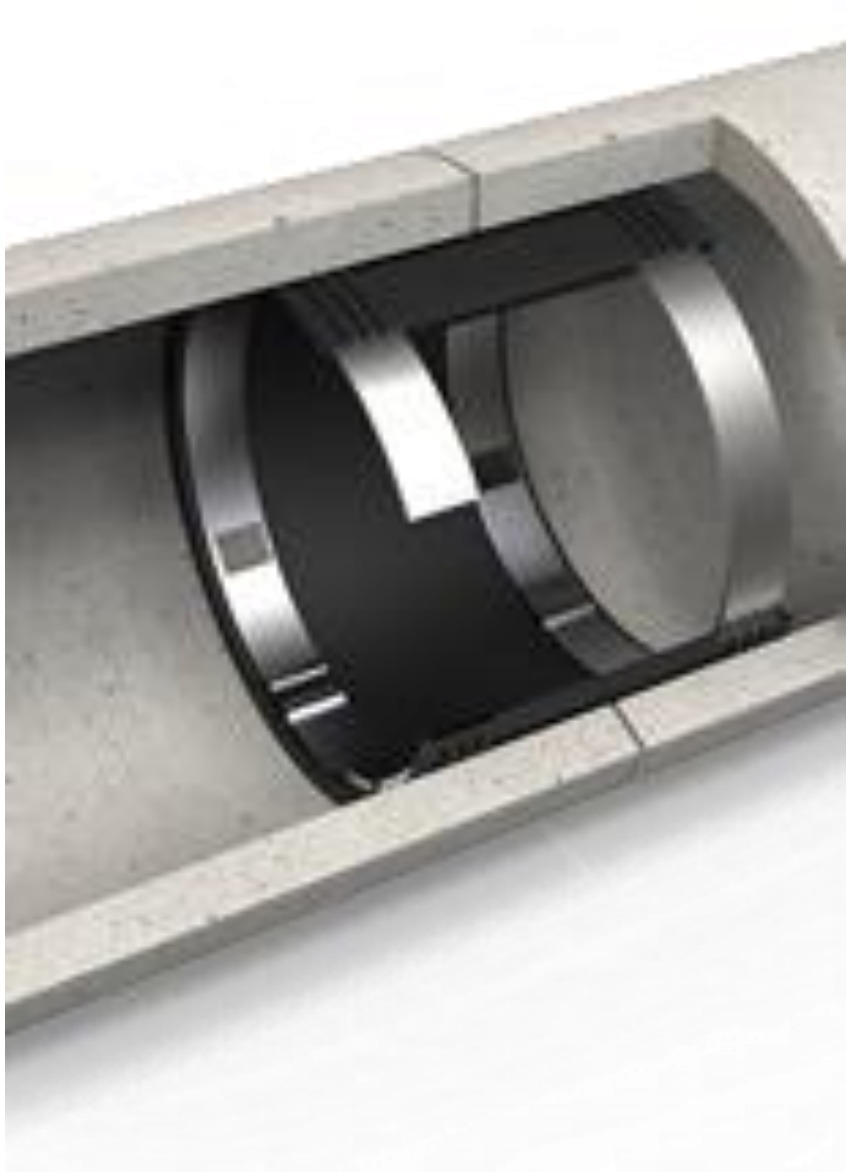
Advanced Inspection Device

tRIIO/ Cadent Lane Rental Industry Publication

TRANSPORT FOR LONDON



Introduction

London's existing gas network is old and in need of replacing to a safer, more durable and reliable solution. In order to assist in planning the replacement work, inspections are undertaken to provide insight into the current conditions, ensuring less time on site, minimal outage to service and overall reduction in cost. These surveys are usually carried out while the mains are still live to avoid disruption to customers.

Existing inspections systems are unable to inspect a large percentage of the gas network due to the presence of internal mechanical seals, which were first installed in the mid-20th century to prevent gas from escaping at joints in high profile areas. Rubber seals were placed against the pipe wall over the joint gap, which are held in situ using two metallic retaining bands under tension.

Unfortunately, historical records and maps do not show which sections have these internal seals; and the tether, used to provide power and communications to the system, regularly becomes trapped under the clips. In some cases, systems have to be abandoned at great expense to all parties involved. Due to the frequency of this, suppliers are now not willing to provide equipment to undertake these inspections and the gas industry has had to revert back to trials holes instead.

In response to this, ULC Robotics were engaged to develop a crawler system capable of traversing these seals in larger diameter pipes (24"-48") to enable pre-inspection of mains again prior to replacement.

The Project

The aim of the project was to develop a system which would allow gas suppliers to inspect previously unreachable areas of the gas network.

Upon completion of the fabrication and assembly of the system, it was extensively tested at ULC's facility in New York. Each individual component of the system was operated and evaluated to ensure all features performed as desired. Then the entire system was fully tested to ensure functionality. Various scenarios were simulated to ensure the crawler could be safely removed in the event of component failure. Upon verification that the system was fit for purpose and would be safe for use within the gas network, several locations were identified for live field testing. The system was shipped to the UK arriving in early October 2017.

It was then integrated into an operations vehicle; with the reel and control box installed into the rear of a box van. The van provided generator power, as well as compressed nitrogen gas. Upon integration with the vehicle the entire system was tested again to ensure no issues arose from shipping. A 24 inch diameter test pipe with a bond-and-bolt fitting was used to test the system, as well as train all parties involved with the field testing. The inspection system was repeatedly launched, retrieved and tested to ensure it was functioning well, and the on-site technicians were comfortable with the operation and control of the system.

The Sites

The first site that was identified for field testing was a 36 inch diameter main on Cheyne Walk, Chelsea Embankment. Unfortunately, once the gas main was exposed it was found to be located directly below a small diameter water main and the field test location was abandoned.

Field testing resumed in early January 2018, after the holiday work embargo was lifted. Three new locations were identified and prepared by tRIIO to allow the system to have significant testing opportunities over a short timeframe. The three locations each consisted of a 36-inch diameter main and contained a section of larger diameter cast iron that was scheduled to be replaced in the near future;

- Chelsea Embankment (A3212) and Battersea Bridge (A3220)
- St Leonards Road, London
- Brompton Road, Knightsbridge

Throughout the field testing a total of 677 meters of live, 36-inch diameter pipe was inspected. The longest continuous inspection was 250 meters. A total of 206 WEKO Seals and 14 Strip Seals were successfully traversed with the cable never getting caught on any seal. The longest WEKO Seal was approximately 5 meters and contained 15 support bands. The longest Strip Seal was approximately 2.2 meters with 8 support bands. The crawler also navigated through eight 11.5° bends and two 22.5°-degree bends. Throughout the trial numerous obstacles were encountered and the system was able to pass through unencumbered.

Outcomes

There were four measures of success which the project aimed to achieve;

Total distance surveyed per job

The robot drove 250m successfully in one direction saving 5 holes from being dug on one of the project tests sites.

Duration of time to complete

The project was completed in 10 days, allowing for reinstatement, saving 25 days.

Robot not getting stuck

The robot did not get stuck on any of the 3 test sites. Digging less holes as a result of the robot Of the three tests sites which were completed 3 holes were dug, saving 8 excavations.

While these were less than anticipated, there has still been a great benefit to using this technology when compared to the baselines.

In addition, there were also the following benefits realised;

- Reduction in spoil – 90m3
- Reduction in CO2e – 18 tonnes
- Reduction in congestion – 20 miles
- Betterment of mapping capabilities – unknown entities now mapped
- Improved image – improved management of works / less disruption

Lesson Learnt

The testing performed in both the controlled environment and field testing providing an opportunity to evaluate the system and gain insight into how it would perform within the gas network. A number of features were identified that could be improved on; however, most of these are minor yet would improve on the durability, reliability and usability of the system.

Some features that were identified:

- More durable jacket material on cables to improve durability.
- Redesign of rear lighting or electrical connector as the latter cancelled out the other.
- The drive gear material to be changed to increase the durability of the gears.
- Optimize the control interface and the synchronization of the different motors, so the operator can concentrate on the inspection rather than the control of the system.
- Design and fabricate a permanent inspection vehicle to house the system and provide all necessary support equipment.
- Explore available options to lift the system onto and off of the valve, to reduce the cost of operations.

Conclusion/ Recommendation

The system was displayed at the Low Carbon Network Innovation Conference in Telford, UK on December 6th & 7th 2017. This provided for an opportunity to share information about the project and the technology with other gas networks that were in attendance.

Upon completion of the field testing, Cadent gave approval for the potential use of the system within their gas network and it is hoped that other networks will adopt the technology to further improve the efficiency of large diameter main replacement programmes.

The technology also has the capability to increase the percentage of pipe that can be internally inspected, improving other areas of pipeline operations and maintenance. Overall the project has proved to be successful. The system will now be developed further based on the suggested improvements and the system promoted further for use in the industry.

TfL Lane Rental Scheme

Optimising customer journeys through the delivery of safer, innovative and sustainable roadworks

Author

tRIIO / Cadent Gas Limited

Date Created: February 2018

Email: LaneRentalFunding@tfl.gov.uk