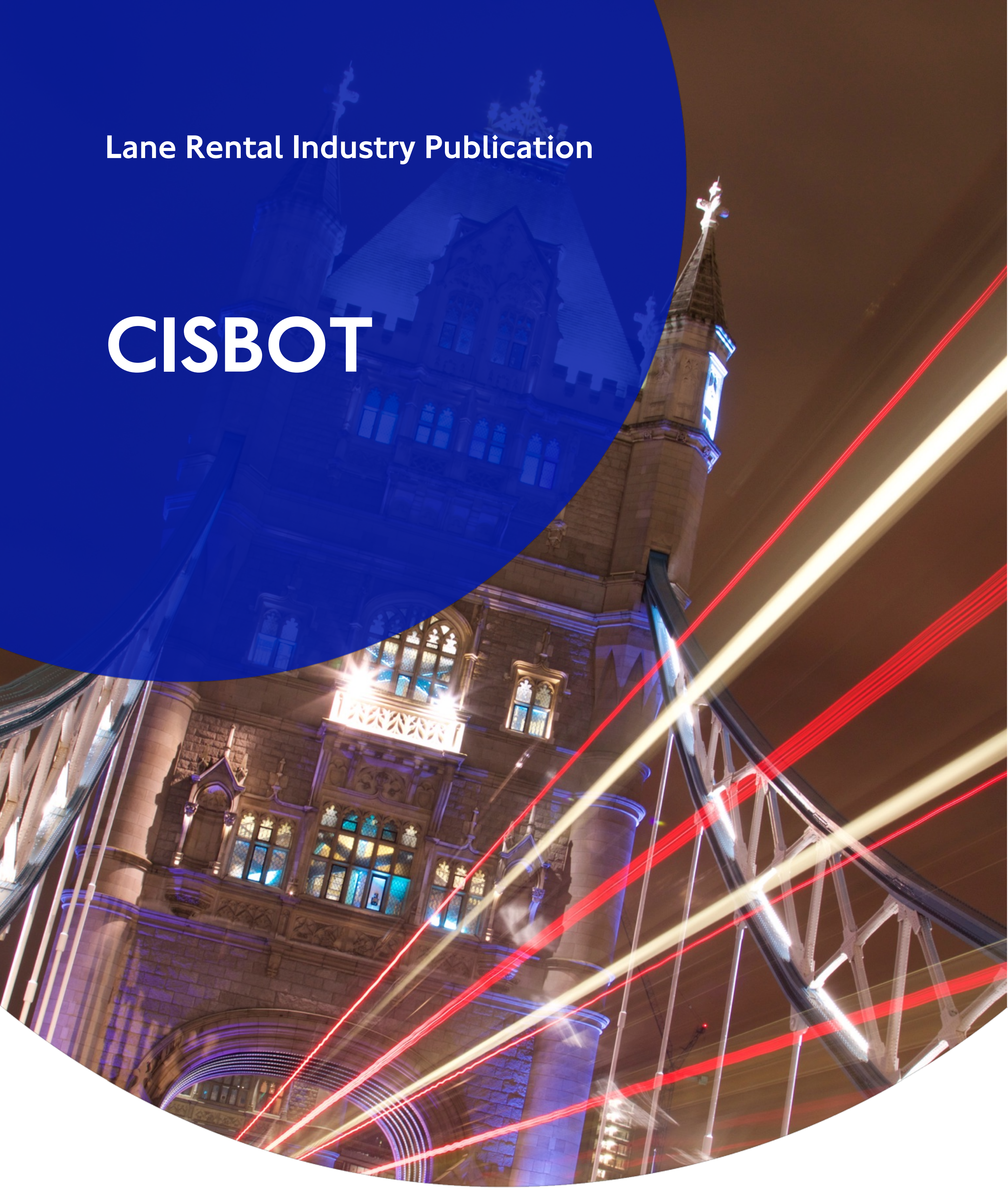
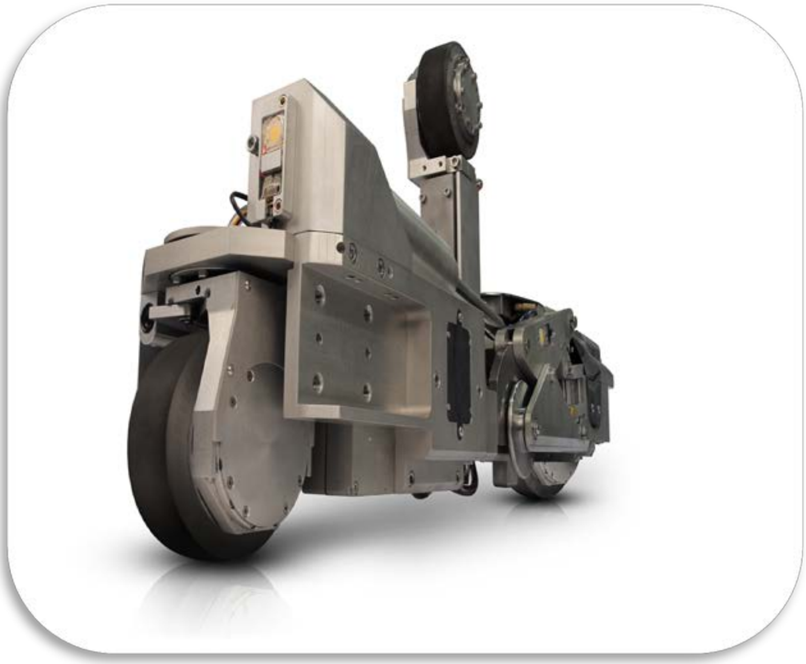
Lane Rental Industry Publication

CISBOT



EVERY JOURNEY MATTERS

SGN Large CISBOT



Introduction

Cast iron mains were used extensively across the gas distribution network. The industry has moved away from this material and has replaced it with steel and polyethylene. At present across SGN's network, there are approximately 843 kilometres of metallic mains that are ageing and requiring inspection, repair or replacement. These sections of mains were connected using joints that are prone to leaking.

Typical repair methods currently pinpoint one or more leaking joints for repair. Multiple excavations are then performed or a linear trench over one or more joints. Repair or rehabilitation methods are then conducted which include encapsulation, external joint injection or the installation of an internal pipe liner. These processes require significant human and financial resources to perform the investigation, permits, excavation and restoration necessary to repair the joints. These methods further result in repeated utility visits, road works, lane closures, noise, pollution and traffic.

CISBOT robotic joint sealing robots renew cast iron pipes by internally injecting all of the joints in a given area with an anaerobic sealant. CISBOT operates in live gas mains with no disruption of services to customers. Only one excavation is performed from the rear of a single box truck making the work less visible and decreases the amount of traffic, disruption, noise, pollution and excavation required. This dramatically reduces the inconvenience to the public by minimising the footprint and duration of road works.

This trenchless technology provides significantly less overall work duration and a more accurate planning process. The result is fewer road closures and delays from multiple excavations, restoration and required permitting. Rather than just repairing known leaks,

CISBOT can rehabilitate joints so they don't become a problem in the future. This proactive approach can prevent the cost and disruption associated with future excavations and external sealing while decreasing the social costs of repeated visits and excavations on troublesome mains.

The Project

As the diameter of cast iron gas mains increase, the cost associated with repairing, rehabilitating and replacing these pipelines increases considerably. In order to access larger diameter mains, larger excavations are required on the roadways and pavements they are buried under.
As pipe diameter increases, durations of projects are typically longer and more difficult to plan; reducing the reliability and accuracy in project time estimates and road and pavement closure durations. Solutions which

decrease the amount of excavation and work time associated with larger diameter pipelines yield substantial benefits to commuters and the driving public while decreasing the level of planning required by government agencies and gas distribution network managers.

Prior to this project, the large diameter CISBOT operation has only been performed on 15”, 16”, 18”, 20” and 24” pipelines. This initiative between ULC Robotics and SGN has performed the world’s first ever 30” pipe rehabilitation program using a robotic system. This ground-breaking work will now expand the options that gas utilities have when rehabilitating large, cumbersome pipelines.

The work at Peckham Road has fostered new capabilities that will enable the CISBOT system to operate in 30” pipe systems. This new capability can now be utilised by all of the Gas Distribution Networks (GDNs) across the UK to decrease roadworks and reduce the necessity for high levels of engineering and operational resources which were previously required during the planning and execution of 30” cast iron projects.

Under this field deployment, operational challenges and planning related to the larger sized deployment were overcome. SGN and ULC Robotics worked closely to de-risk the operation while developing and refining procedures and processes that can now be utilised for future field deployments of the system across the UK (these can be made available upon request to support the use of the system). By enabling the CISBOT system to seal 30” cast iron main, significant disruption was avoided with durations reduced.

This CISBOT site was evaluated to determine:

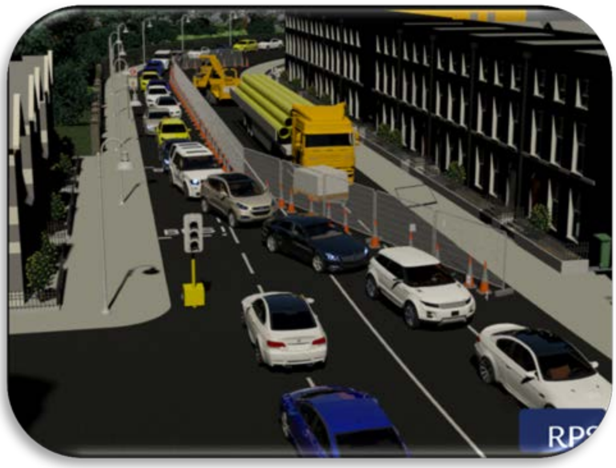
- Unknown obstructions and features within the main
- Precise location of gas mains, services, tees and fittings
- Excavation locations
- Water or excessive debris in the main
- Joint spacing and pipe sizing
- Joint construction

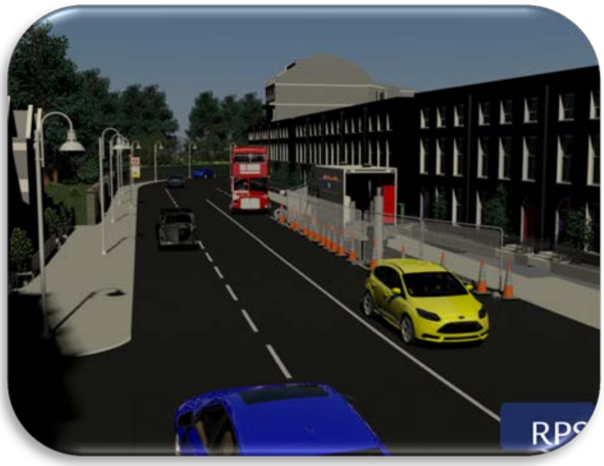
Outcomes

The SGN Large CISBOT pilot field trial has been a significant success, both in terms of innovation application and cooperative development of existing anaerobic sealant leakage repair principles that allow rehabilitated cast iron pipes to have a substantial increase in asset life and reduction in associated risk. This methodology provided a substantial enhancement to existing proven repair techniques and will potentially evolve for other internal pipe applications with the current positive innovation promotion being applied to develop the use of robotic technologies further for the GB GDNs by SGN.

This CISBOT system greatly reduced inconvenience to the public, made work less visible and decreased the amount of excavation required compared with other joint repair or pipe replacement methods such as encapsulation or lining. This trenchless technology provided significant cost savings by decreasing the expenditure necessary for taking the main out of service, multiple excavations, restoration of road surfaces and the associated traffic management.

When comparisons are made between the cost of conventional methods and robotic methods, it is clear that using CISBOT provided greater financial savings. The main source of the social cost is due to traffic delays. When a conventional method was used (with multiple excavations), it was estimated that there would be traffic disruptions for 420 days. CISBOT sealed the same number of joints in 159 days. This clearly highlights the financial savings but, more importantly – the reduced inconvenience for road users. The estimated cost savings of the robotic system are significant and it also satisfied each criteria in the guidance document set by the LRGC for innovation funding.





The illustrations above show the differences when conventional techniques (left) are used compared with robotic methods. Clearly, there is a much lower impact on road users when CISBOT is in use.

Lessons Learnt

As part of the practical elements of the trial, some modifications to the operating system were identified to make the system fully compliant with UK regulations.

SGN have identified strategic mains across its network where the Large CISBOT system can be utilised. The commercial package of works contains a variety of mains with varying diameters, surrounding and pressure tiers to test the system further.

As part of the practical field trial, SGN invited all of the GB GDNs, Ofgem and the Health and Safety Executive to visit site for a presentations and practical demonstration of the system in operation. All useful observations were recorded and noted in the field trial report.

Conclusion / Recommendations

Considering the broad cost implications of applying the large CISBOT system relative to the existing external injection lead yarn joint repair method, they are only compared on an achieved productivity basis because of the commercial and financial sensitivity of the SGN/ULC Robotics business arrangements. However, from the experience SGN have of using the system on other pipe diameters, a joint completion level averaging approximately 5 per day is often achieved (without 24 hour working or extended operating hours to satisfy specific site conditions).

To achieve this productivity rate utilising conventional external anaerobic sealant joint repair methods from a programmed joint repair project would only be realised over a 7-10 day period without saturating the work area with additional repair teams and associated resources. In addition many external factors that require significant consideration would also need to be applied such as:

- Highway access liaison and traffic management
- Substantial excavation, reinstatement and disposal requirements
- Increased risk of utility interference
- PR issues relative to disruption, especially in London
- Consistency of anaerobic sealant application

It is estimated from previous operational experiences of similar large diameter lead yarn external anaerobic joint repair activities that the CISBOIT™ system productivity rate was approximately 10 x greater, with significant logistical and financial benefits from the reduction / removal of peripheral factors associated with any excavation activities.

Primary recommendations

- Carry out a post-trial joint evaluation of the pilot field trial to check effectiveness of the CISBOT sealing process

- Review the sealing gland arrangement for the robotic unit tether on the launch tube to remove any gas leakage during normal CISBOT operations

- Finalise CISBOT lifting equipment inspection as launch tube lifting bar has been inspected under Lifting Operations and Lifting Equipment Regulations (LOLER) principles but the hook attachments can be separately removed and should be separately checked and tagged

- Fit appropriate guards to identified entrapment areas on the feeder motor and tether drum chain mechanism

As well as remediating all of the joints on a given section of main, an asset integrity report is created containing detail of all auxiliary items found as part of the survey works, the exact location of every joint, and the camera footage taken.

SGN believe that the combination of the remediation of all of the joints and the data collated and as a result of the works considerably increases the asset life of the main. Without conducting extensive and costly laboratory testing it is difficult to quantify an exact figure for the asset life extension. A study was previously conducted at Cornell University for ULC Robotics, using three removed joints that had been remediated by the CISBOT system. The study determined the extension to the life span of the joints to be 50 years. In light of the practical trials conducted by SGN as part of this project and the University report, SGN estimate a conservative figure of between 15 and 20 years.

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