Manitoba Hydro is a natural gas and electricity supplier based out of Winnipeg, Manitoba, Canada with 580,000 electrical and 284,000 natural gas customers. Over the summer of 2019, Manitoba Hydro worked with Pipetel Technologies to plan and execute the robotic inspection of the Brandon lateral, approximately 5 miles (8.25 km) of 10-inch, otherwise “unpiggable” pipeline north of Brandon, Manitoba.

Across the globe, there are pipelines that prove difficult to inspect using traditional methods. Whether the infrastructure has challenging features, impassable components, or little to no flow; launching and receiving inline inspection pigs may be impractical or impossible.

Since 2011, Pipetel Technologies has been working to mitigate the challenges of traditional pigging by utilizing their fleet of tetherless robotic crawlers known as Explorer iLi. Ranging from 6 to 36 inches in diameter, Pipetel’s Explorer iLi robots are able to perform Magnetic Flux Leakage (MFL) sensing, Laser Deformation Sensing (LDS), and video inspection on pipelines that are in or out of service. Additionally, Explorer iLi robots can be recharged inside the pipe using proprietary in-line charging (ILC) technology, allowing the inspection of long distances. The ILC system operates as illustrated in Figure 1.

THE PIPELINE INSPECTION CHALLENGE FOR MANITOBA HYDRO

The Brandon lateral stretches between the city of Brandon and the hamlet of Forrest; 5 miles of pipe that had never previously been inspected. The limits of the segment to be inspected were defined by a plug valve and a valve station; both unsuitable for launching and receiving traditional pigging equipment. Additionally, as the pipeline had been built in the 1950s, pipeline geometry, fittings, wall thickness, and cleanliness were all unknown factors. Furthermore, there was a possibility of different pipeline diameters within the segment and a feasible location to add a permanent pig launcher was not available. These were all reasons to look for an alternative inspection method.

The inspection of the Brandon lateral posed numerous challenges for inspection such as the unknown geometry of the pipeline, the number of fittings and excavations required, the trajectory of the pipeline through farmland, as well as potential weather delays. Given the uncertainties of the pipeline composition, the decision was made to inspect the pipeline out of service. In order to complete the project successfully, inspection solutions that can overcome these uncertainties and challenges were required.

Pipetel’s Explorer iLi robots are tetherless and battery operated, which means they have a finite distance they are able to inspect before they must be recharged. In lieu of numerous size-on-size hot tap fittings, recharging stations were added to the pipeline thereby reducing the number of times the Explorer iLi robot would be removed from the line. Working together, Manitoba Hydro and Pipetel determined 13 sites were required along the pipeline length. Manitoba Hydro worked with the land owners and their farmland to determine the optimal locations.
Special consideration was given to how far equipment would need to travel over farmland, as rain and mud could make excavations inaccessible.

**ROBOTIC PIPELINE INSPECTION**

Given the 10-inch pipe to be inspected, the Explorer iLi 10/14 was used for the inspection of the pipeline. Explorer iLi 10/14, shown in Figure 2, is capable of inspecting 10- to 14-inch pipe both in and out of service.

Unlike a traditional pig, Explorer iLi robots are driven remotely by a Pipetel operator. The operator is able to control where the robot travels and how quickly it moves. Should the operator come across any previously unknown feature, it can be documented in real time and the decision to continue or turn back can be made. A view from the inside of one of the hot tap fittings is illustrated in Figure 3.

Explorer iLi does not require permanent launchers and receivers to be installed on the pipeline. Instead, the robots are able to launch through size-on-size hot tap fittings. Manitoba Hydro set up four of these launch and receive sites along the 5 miles.

During an Explorer iLi inspection, operators have the ability to either launch and receive from a single fitting, or launch at one site and receive at another. Given the fittings on the pipeline, both methods would be utilized on the project. As outlined in Figure 4, Explorer iLi 10/14 was launched and received at the same location one time, and completed the remainder of the inspection by travelling from launch site to launch site.

**Figure 3: 10 Inch Hot Tap Fitting**

**Figure 2: Explorer 10/14**

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As Explorer iLi robots are battery powered, their inspection range is limited by battery capacity. In an effort to extend the range of the Explorer iLi fleet, Pipetel implements a proprietary in-line charging (ILC) system. In effect, by adding “refueling” stations along the pipeline, the number of more costly entry and exit fittings can be reduced. Each charging location is much smaller than a launch site and proves less impactful on the pipeline surroundings. In total, nine charging sites were utilized during the inspection. An example of an In-line Charge site is shown in Figure 5.

By utilizing in-line charging technology, pipeline operators are able to execute longer robotic inspections than would otherwise be possible. Manitoba Hydro was able to leverage Pipetel’s ILC such that the launch system, outlined in Figure 6, would only be utilized four times. Reducing the quantity of launch sites reduced capital expenditure and the time required for inspection. Since the Explorer iLi robot did not need to come out of line as frequently, the inspection was completed in nine days.

**PIPETEL’S PERFORMANCE AND DATA**

Whenever launching into a pipeline that has not been inspected before, the conditions of the pipeline are unknown. Be it pipe cleanliness, geometry, or inspection equipment malfunction; collecting high quality data can be challenging in these situations. For Explorer iLi, many of these challenges are mitigated by being able to control the robot in real time. While executing an inspection, real time video, MFL data, and deformation data are transmitted to the operator so that they are able to make informed decisions about tool passage and data quality.

Once the inspections began, the line was found to be quite clean, with minimal debris inhibiting Explorer iLi’s travel. Through the 5 miles of inspection, Explorer iLi averaged over 99 percent for MFL and LDS data coverage respectively. Over the 5 miles, previously unknown taps and bottom out fittings were discovered.

**SUMMARY**

When inspecting the Brandon lateral, many of Manitoba Hydro’s challenges and costs came from adding the multiple fittings required by the Explorer iLi robot and charging equipment. As Pipetel looks to the future, in order to reduce the required number of fittings on the pipeline, the range of Explorer iLi must be extended. Multiple initiatives are underway to both reduce the energy demands of Explorer iLi as well as optimize charging to prove less impactful on the inspection’s surroundings.

Manitoba Hydro was successful in inspecting the 5-mile Brandon lateral using Pipetel’s Explorer iLi and Pipetel was able to collect high quality MFL, Laser Deformation, and video data with over 99 percent coverage. By utilizing Pipetel’s launcher and in-line charging, the long length of unpiggable gas line was inspected in only nine days.

**ABOUT THE AUTHOR:**

Scott Chamourian is a project manager and has worked with Pipetel Technologies since 2013. He has worked as part of the operations team as well as in his current role planning and executing inspections. Scott received his Bachelors of Engineering from Ryerson University.